Children's Understanding of Belief

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Gopnik (1993) reports that young children do not understand their own beliefs before they understand the beliefs of other people. Gopnik argues that the young child develops a theory of mind which grows in complexity over time, and is simultaneously used to explain the child's own behaviour, and that of others, in terms of psychological states. Gopnik's position is called "theory theory". Harris (1989, 1991) proposes an alternative explanation of Gopnik's findings, in which the young child does not develop a theory of mind, but rather 'simulates' their intuitive understanding of their own psychological states in order to explain the behaviour of others. Harris' position is called "simulation theory". In the present study a third position is proposed, "first-person theory theory", which occupies the middle ground between theory theory and simulation theory. First-person theory theory states that the young child begins to theorise about their own psychological states after having become reflectively aware of their own psychological experience or "stream of consciousness", and that the child's theory of mind is later used to explain the behaviour of others. The present study tested the developmental priority of self knowledge by comparing three-year-old children's understanding of false belief in others and representational change in themselves. The present study also tested the hypothesis that heightened cognitive involvement, caused by participation in the execution of the experimental task, would increase children's accuracy on questions about their own false beliefs to a greater degree than it would their accuracy on questions about another person's false beliefs. Subjects responded with greater accuracy to questions about where they had personally looked for a hidden object than they responded to all other test questions. The findings of the present study supported the developmental priority of self knowledge proposed by first-person theory theory and simulation theory, while constituting evidence against theory theory.

During the preschool years, young children begin to develop an understanding of psychological states such as perception, desire, and belief. At approximately three to four years old the child begins to evidence an understanding of the representational nature of belief - that beliefs are *about* something, and that beliefs can be false (Gopnik, 1993).

The central aim of the present study is to find out whether young children develop an understanding of their own false beliefs before they understand the false beliefs of others, and whether greater cognitive involvement in situations which involve false belief better facilitates the development of the child's understanding of their own false beliefs than it does the child's understanding of false belief in others.

In part one of the introduction, "the child's theory of mind", evidence will be presented which suggests that young children, children with autism, and some animals do not have the neurological 'equipment' necessary to intuitively understand psychological states. I will then argue that the child's developing understanding of psychological states is dependent upon a neurological mechanism which is not present in some animals, and is damaged in children with autism. I will then discuss the specific functional nature of the neurological mechanism, and compare several candidates for that specific function.

In part two of the introduction, I discuss the development of the theory of mind in three sections. The three sections describe development during the first three years of the child's life, the child's degree of understanding at three years of age, and later development, respectively. The subjects in the present study are three years old, and part two of the introduction serves to put their level of understanding of psychological states in context with the greater developmental process.

In part three I will introduce my account of the child's developing understanding of psychological states, "first-person theory theory", which provides an alternative to the models described in part two of the introduction. 'Hard' theory theorists such as Gopnik (1993) claim that the child develops a theory of mind to simultaneously explain the child's own behaviour and the behaviour of others. First-person theory theory, on the other hand, states that the child's developing theoretical understanding of psychological states is first applied to their own behaviour, and is only later applied to the behaviour of others. The version of first-person theory theory put forward in part three also states that the child's theorising about their own psychological states is initiated by the first reflective awareness of their own "stream of consciousness" or "psychological experience" (Gopnik, 1993).

In part four I will introduce the present study. I will describe the study in general terms, discuss the interpretation of results, and finally discuss relevant methodological issues.

In summary, the present study is concerned with the developmental priority of self knowledge, and the role of awareness of psychological experience in theory of mind development. In part one I establish the case for the existence of a theory of mind module. In part two I will describe the development of the child's understanding of psychological states, which is dependent upon that module. In part three I will present the first-person theory theory, and in part four I will introduce the present study, which will test first-person theory theory.

PART ONE: THE CHILD'S THEORY OF MIND

In this section evidence is presented that children with autism, some animals, and young children lack understanding of psychological states. I will argue that understanding of psychological states is dependent upon a specific neurological mechanism which is damaged in children with autism.

Without understanding.

It is hard for most people to imagine what it would be like to know nothing about mental states. Human action is often (if not always) determined by desires, and those desires are reliant upon beliefs (Wellman, 1990). For this reason, any person who wonders about the causes of human behaviour and is unaware of desire and belief is going to be a long way from a full understanding of why people do many apparently inexplicable things, such as walking in and out of rooms (Baron-Cohen, 1995). Whenever we have a conversation with another person we take into account that person's beliefs, desires, and perceptions. We can lie or deceive others because we understand that they can hold false beliefs. An understanding of the representational nature of the mind, that mental states refer to some content and can often be false, greatly facilitates our everyday lives.

Thinking about the number of things that a person couldn't do if they did not have an appreciation of "mind", it soon becomes apparent that such a deficit would have disastrous social consequences for the afflicted individual. As most people do not like

to feel constantly bewildered or unsure of their surroundings, such a person might withdraw from social interaction or keep to themselves.

Kanner (1943) described a group of people who appeared to fit this description exactly. Extracts from some of his descriptions of the children he observed include the following:

> "He seems almost to draw into his shell and live within himself..."
>
> "When taken into a room, he completely disregarded the people and instantly went for objects..."
>
> "When a hand was held out to him so that he could not possibly ignore it, he played with it briefly as if it were a detached object..."
>
> "He did not respond to being called, and did not look at his mother when she spoke to him..."
>
> "...on a crowded beach he would walk straight toward his goal irrespective of whether this involved walking over newspapers, hands, feet, or torsos, much to the discomfiture of their owners. His mother was careful to point out that he did not intentionally deviate from his course in order to walk on others, but neither did he make the slightest attempt to avoid them. It was as if he did not distinguish people from things, or at least did not concern himself about the distinction."

The children described by Kanner were autistic, and recent clinical observations (e.g. Baron-Cohen and Bolton, 1993) are remarkably similar to Kanner's. Autism occurs in approximately four to fifteen children per ten thousand, across social and cultural boundaries. There appears to be a genetic basis to the disorder, with a higher than chance rate of children who are closely related to a child with autism also having

the condition. In cases where autistic children have siblings, the rate of autism in their brothers and sisters is approximately two percent, which is a morbidity risk fifty times greater than that of the general population (Rutter, 1967). Folstein and Rutter (1978) found that in ten pairs of fraternal twins, one of whom in each pair had autism, not one of the other twins were autistic. In eleven pairs of identical twins (one of whom had autism), however, thirty six percent of the co-twins were also autistic. Autism is associated with biological abnormalities such as mental handicap, epilepsy, and various other brain pathologies (Baron-Cohen, 1995; Folstein and Rutter, 1978). The genetic basis of autism causes brain abnormalities, which in turn cause the behavioural symptoms of the disorder. If there is a single common brain abnormality shared by sufferers of autism, it may be damage to the neurological substrate of a specific cognitive function: the ability to develop an understanding of psychological states (Baron-Cohen, 1991; Baron-Cohen, Leslie, and Frith, 1985; Leslie, 1987).

Baron-Cohen, Leslie, and Frith (1985) were the first to ask the question; "does the autistic child have a theory of mind?". Baron-Cohen et al. tested children with autism on a false belief task using puppets, and concluded that the postulated dysfunction of the autistic child's theory of mind was independent of mental retardation and specific to autism, which suggests that the cognitive deficit which causes autism is relatively specific. The task tested the children's ability to understand that a person (or in this case, a puppet) can hold a false belief as one puppet "deceives" another by changing the location of a marble while the second puppet is "out of the room". The results of the study indicated that children with autism failed the false belief test, while normal children and children with Down's syndrome passed.

Autism can be diagnosed at a fairly early age on the basis of key symptoms such as an inability to form proper infant-mother attachment, and abnormal social and communicative development (Baron-Cohen, 1995). Various aspects of the autistic child's apparent lack of social competence have been investigated by researchers. Children with autism show deficits of pretend-play (Baron-Cohen, 1987; Ungerer and Sigman, 1981) or understanding of deception (Russell, Mauthner, Sharpe, and Tidswell, 1991). Children with autism fail to interpret behaviour in terms of intentions, feelings, or beliefs (Frith, 1989), false belief (Baron-Cohen, 1988; Baron-Cohen, Leslie and Frith, 1985; Perner, Frith, & Leekam, 1989), and desire (Harris and Muncer, 1988). Autistic children are, however, as capable as normal children at interpreting a cartoon-strip sequence of events which is purely mechanistic. An example of a 'mechanistic' cartoon sequence is one in which a girl is shown holding a balloon, and when she loses her grip the balloon blows away on the wind. An example of a 'mentalistic' cartoon sequence is one in which the girl puts down a teddy bear to pick fruit, the teddy bear is taken away by another child while the girl looks away, and when she turns back the little girl is surprised to see that the bear is missing. The subject must understand psychological states in order to successfully put the cartoon in the correct sequence (Baron-Cohen, Leslie, and Frith, 1986).

The case of autism has provided an example of a genetic pathology which causes some individuals to be born "mindblind" (Baron-Cohen, 1995). That is, autistic individuals do not comprehend the nature of mental states. The apparent existence of a genetic pathology which can cause "mindblindness" has led some theorists (Baron-Cohen, 1995; Leslie, 1987; Leslie, 1991; Leslie, 1994) to posit the existence of a "theory of mind module" - a discrete cognitive information processing unit in the brain which is

the neurobiological basis of the child's theory of mind, or plays a crucial role in the development of that theory. Baron-Cohen (1995) explains that "..the genetic pathology that caused a body to be built without a stomach would be further evidence for the evolution of the stomach" (p.10).

Certain animals do not evidence any understanding of psychological states, perhaps because the necessary neurological mechanism has not evolved in those species. Studies of the behaviour of vervet monkeys in Kenya by Cheney and Seyfarth (1992) have shown that these primates apparently have no theory of mind, but rely instead upon complicated behavioural observations to predict each other's actions. The evidence for this conclusion is that the behaviour of vervet monkeys, ranging from a few simple vocal responses to predator avoidance behaviours, does not appear to take the intentional states of other monkeys into account. For example, vervet monkeys will give the same vocal response to the presence of a predator regardless of whether they are alone or in a group. In contrast, a chimpanzee will flee a predator in relative silence if there are no other chimpanzees present to hear any distress calls or predator warnings, but if other chimpanzees are present it will give the appropriate calls (Cheney and Seyfarth, 1992).

Baron-Cohen (1993b) and Happe and Frith (1992) have suggested that high-functioning individuals with autism are those with higher nonsocial intelligence. Those individuals with higher nonsocial intelligence may learn to predict the behaviour of others on the basis of learned rules and behavioural observation analogous to the method used by the vervet monkeys.

In summary, there is evidence of a specific cognitive deficit in autism which apparently has some genetic basis. Coupled with findings that not all of the primates exhibit behaviours that would be expected if they had a theory of mind, this evidence has

been used to argue for the existence of a neurological module in humans which specialises in processing information about the hypothesised mental life of ourselves, and of other people.

The suggestion that animals such as vervet monkeys do not have the necessary neurological mechanism to develop understanding of psychological states is intuitively compelling, but only one of several possibilities. For example, the proposed neurological mechanism may not exist, and the vervet monkeys simply might not have a form of social interaction or 'culture' which is conducive to the development of understanding of psychological states.

The evidence from autism for a neurological substrate of the ability to understand psychological states is fairly convincing. Autism is characterised by a recurring genetic trait which causes brain abnormalities (Baron-Cohen, 1995; Folstein & Rutter, 1978; Rutter, 1967). It is probable that a particular brain abnormality which is common to autism causes a specific cognitive deficit, and that deficit could in turn cause the major symptoms of autism. Baron-Cohen (1995) and Baron-Cohen et al (1985) claim that the cognitive deficit responsible for autistic symptomatology is the inability to develop an understanding of psychological states. In short, the evidence from autism suggests that that the development of understanding of psychological states in normal humans is reliant upon a specific neurological substrate.

Although the existence of a genetic pathology such as autism, which causes an individual to be unable to comprehend psychological states, suggests the existence of a processing mechanism in the human brain which is responsible for that task, it does not indicate the nature or specific function of that mechanism. The possible nature of such a mechanism is discussed in the next section.

Theory of mind module.

The evidence from autism discussed in the previous section suggests that the development of the ability to understand psychological states in normal humans is reliant upon a specific neurological substrate. In this section I will discuss the various models of the child's understanding of psychological states which the proposed neurological mechanism might support. I will then compare the models of understanding, and argue that the child's understanding of psychological states is best described as a "theory of mind" (Premack & Woodruff, 1978). The theory of mind, and the neurological substrate of that theory, are thereafter referred to as a "theory of mind module" (Fodor, 1983).

The psychological module is described by Fodor (1983) as being an informationally encapsulated computational system. Such systems are said to be semi-autonomous centres or circuits of neural activity which take care of discrete processing tasks without significant interruption or contact by other modules. A set of informationally encapsulated modules would allow differentiation of function throughout the brain, and theorists have suggested that one such module is either explicitly responsible for 'theory of mind' processing, or at least performs a function which is necessary for the development of the theory of mind (Baron-Cohen, 1995, Brothers and Ring, 1992, Karmiloff-Smith et al, 1995, Leslie, 1987, Leslie, 1991).

Once we have accepted the possible existence of a module upon which the development of understanding of psychological states is dependent, it is prudent to ask what specific function this hypothetical module might perform. It can be argued, for example, that there is a 'metarepresentation module', a 'social intelligence module', a

'simulation module', or a 'theory of mind module'. This section will discuss each possible specific function of the proposed module.

Metarepresentation.

A good candidate for the function of the proposed module is metarepresentation. Leekam and Perner (1991) put forward two distinct definitions of metarepresentation, both of which are described here. Metarepresentation can be defined as the process of representing representations, and it can also be defined as the process of representing *mental* representations. Whether there is a specific metarepresentation module in the human brain, and which type of metarepresentation information that module might be responsible for processing, is discussed in this section.

Leslie (1987) claims that there is a neurobiological system or module which is responsible for the capacity for metarepresentation in humans, and that damage to this module will lead to an inability to develop a theory of mind. Development of the theory of mind depends upon the metarepresentational process for the simple reason that it is impossible to think about another person's thoughts (or even one's own thoughts) without making representations of representations.

Leekam and Perner (1991) have criticised Leslie's claim that a theory of mind deficit in autism is due to an inhibited ability to metarepresent. Leekam and Perner tested autistic children's understanding of photographic representations with Zaitchik's (1990) photograph task, which was modelled on the false belief task (Baron-Cohen, Leslie, and Frith, 1985; Wimmer and Perner, 1983). In the photograph task, children were first instructed on how to use a Polaroid camera. They then took a picture of an object in location A. Instead of a person putting an object in location A and leaving the

room, as in the false belief task, a photograph is taken of the object in location A. While the Polaroid photograph is developing, the object is moved to a new location (B), just as in the false belief task. The child then had to predict where the object will be in the photograph (Leekam and Perner, 1991, p.206). Although normal subjects could pass either test with equal ease, the autistic children could apparently represent the representations of a polaroid camera, but not those of the doll. Leekam and Perner concluded that the autistic children's failure on the false belief task was not attributable to a metarepresentational deficit, or at least not a deficit of metarepresentation as defined by Leslie (1987, 1988). Leekam and Perner argued that if autistic children have a metarepresentational deficit in Leslie's sense of the term, then they should have difficulty not only with mental representations such as false beliefs, but also with external representations such as photographs. Leekam and Perner's results suggest that there is a qualitative difference between the metarepresentation of non-mental representations, such as the Polaroid, and the metarepresentation of mental representations, such as beliefs. In response to Leekam and Perner, Leslie and Thaiss (1992) have suggested that the child's understanding of mental states is domain specific, and that it develops in parallel with understanding of non-mental representation. Although Leslie's (1987) original claim was that young children were unable to perform any sort of metarepresentation, mental or non-mental, Leslie and Thaiss (1992) concede that young children can in fact represent non-mental representations.

Leslie (1987, 1988) claims that autistic children do not have a theory of mind because of a metarepresentational deficit. Leekam and Perner (1991) have demonstrated that autistic children are in fact capable of representing non-mental representations. The weaker claim, that the development of a theory of mind has been

inhibited by a deficit of the ability to represent *mental* representations may be valid. It is not, however, the claim made by Leslie (1987, 1988). If there is a qualitative difference between the representation of mental and non-mental representations, then there may be a module which is responsible for the ability to represent mental representations. The evidence discussed here suggests that there is not a metarepresentation module upon which development of the ability to understand psychological states depends.

Social intelligence.

Autistic children and vervet monkeys may have a social intelligence deficit, caused by a damaged or missing "social intelligence module". Baron-Cohen (1993b) and Happe and Frith (1992) suggest that there may be a functional distinction between social and nonsocial intelligence; that autistic individuals with less social impairment are those with higher nonsocial intelligence. The term 'social intelligence' is shorthand for the ability to process information about the behaviour of others and to react adaptively to their behaviour (Baron-Cohen, 1995). It is possible that the difference between representing mental representations and learning fixed mechanical rules (e.g. the nature of Polaroid representation) is in fact the difference between social and nonsocial intelligence. Autistic individuals with higher nonsocial intelligence may be using processes of deduction, which are nonsocial, to "decode" mysterious social circumstances which aren't being dealt with by a damaged social intelligence/theory of mind module.

Those individuals with a damaged social intelligence module may be attempting to compensate by predicting the behaviour of others on the basis of learned rules, while

normal people have a theory of mind which allows one to forego laboriously predicting the behaviour of others in non-mentalistic terms. An analogy can be made with a person who is attempting to predict the responses of an extremely complex machine on the basis of past experience when it would be quicker and easier to simply think of the machine as being sentient, or having Intentionality. Intentionality refers to the capability to refer to something outside oneself, to have "aboutness" (e.g. the word "bee" refers to a particular type of flying insect). The predictive and adaptive value of the "intentional stance", in which one perceives the world as being filled with intentional agents, is high (Dennett, 1987).

The social intelligence deficit described by Happe and Frith (1992) effectively carries out the same function as theory of mind modules like those described by Leslie (1987), and Baron-Cohen (1995). However, a distinction can be made between a social intelligence module and a theory of mind module. The theory of mind module has a single specific function; to develop a theoretical model of the human mind which allows social interaction to occur with much less accompanying cognition than might otherwise have been necessary. In contrast, the social intelligence module may have more than a single specific function to perform, such as affective, theory of mind, and symbolic pretence processing. If it is true that the difference between social and nonsocial intelligence is the difference between representing mental representations and learning fixed rules, and nothing more besides, then the social intelligence module is effectively a theory of mind module by another name. If the social intelligence module is responsible for a wide range of functions which define 'social intelligence', then it is qualitatively different to the neural mechanism described by most theorists as a 'theory of mind module' (Baron-Cohen, 1995; Leslie, 1987). For example, Brothers and Ring

(1992) have postulated a cognitive module, referred to as a 'social module', whose function is to build representations of other people. A social module which is responsible for representing other people is carrying out more than simple metarepresentation, but is also building representations of non-representative social matter.

If a social intelligence module exists which is responsible for a number of information processing tasks, then it is reasonable to expect that there would be examples of damage to this module, which would result in a very wide-ranging (and potentially crippling) loss of social ability. The only disorder which causes such widespread loss of social function, although sometimes completely sparing nonsocial functions, is autism (Davison and Neale, 1990). Baron-Cohen (1995) claims that theory of mind deficit is the cause of autism, whereas Kanner (1943) asserted that the primary deficit was affective. Without further empirical investigation it can only be said that the deficit evident in autism is a social intelligence deficit, but that it remains to be seen whether a social intelligence module is in fact another name for a theory of mind module, or is a neurological mechanism with a greater range of functions.

Theory theory versus simulation theory.

The remaining two accounts of the mechanism through which the understanding of psychological states develops are the two most influential and polar positions in the literature, so they are discussed together here. "Theory theory" (Gopnik, 1993; Gopnik & Astington, 1988; Wellman, 1990) describes the child's understanding of psychological states in terms of an implicit theory, analogous to a scientific theory, which builds in complexity over time. "Simulation theory" (Goldman, 1989, 1992;

Gordon, 1986, 1992; Harris, 1989, 1991; Johnson, 1988) states that the child 'simulates' an intuitive model of their own psychological states in order to understand the psychological states of others. The relative merits of theory theory and simulation theory are discussed below.

The term 'theory of mind' was coined by Premack and Woodruff (1978) in conjunction with their studies regarding the chimpanzee's understanding of mind. Premack and Woodruff defined the theory of mind as follows: "In saying that an individual has a theory of mind, we mean that the individual imputes mental states to [self] and to others (either to conspecifics or to other species as well). A system of inferences of this kind is properly viewed as a theory, first, because such states are not directly observable, and second, because the system can be used to make predictions, specifically about the behaviour of other organisms." (op.cit., p.515).

Gopnik and Wellman (1992) claim that children use an implicit, organised causal-explanatory system with the defining characteristics of theories to explain both their own psychological states, and the psychological states of others. The "coherent body of abstract theoretical constructs" which the child develops is best described as a theory because its primary function is to propose an explanation for the observed behaviour of self and others (Wellman, 1990).

An important division between the theory theory and the simulation theory is the matter of the priority of self knowledge (as opposed to knowledge of others). The matter of developmental priority of self knowledge has been confused with the distinction between theory theory and simulation theory, although it is possible to separate the two issues to some extent. Theory theorists such as Moses and Chandler (1992), and Gopnik (1993) claim that the child's mentalistic concepts are not acquired

for self and then later applied to others, but are constructed as part of a general theory of mind which is equally applied to self and other. However, it is possible that young children develop a theory of mind, but that knowledge of one's own psychological states has developmental priority over knowledge of others (see part three of the introduction for a full description of this position, which is called "first-person theory theory").

Simulation theory states that, rather than theorising about one's own psychological states, the child has an automatic, phenomenal knowledge of their own states, and that simulating this self knowledge allows the child to understand the behaviour and psychological states of others (Goldman 1989, 1992; Gordon 1986, 1992; Harris 1989, 1991, and Johnson 1988). The child simply imagines themselves to be in the place of the observed other, and by considering the output of their own mind the mental states and resultant behaviours of others can be predicted (Gopnik & Wellman, 1992; Harris, 1991; Johnson, 1988).

Theory theory proposes a "causal explanatory framework" of theoretical constructs such as belief or desire which develops as the child matures, incorporating constructs of greater complexity (Fodor, 1992; Lillard & Flavell, 1992; Moses & Chandler, 1992; Wellman, 1990; Wellman & Bartsch, 1988). The child's intuitive understanding of their own psychological states, which is asserted by simulation theorists, is irreconcilable with the concept of a gradually developing causal explanatory framework. If simulation theory is true, then the child should be able to recognise any psychological state in others that they have personally experienced. The simulation theory does not allow for a gradually developing understanding of one's own psychological states. Young children refer to only some mental states in their

explanations, they refer to different mental states at different stages of their development, and their understanding of false belief changes in parallel with their understanding of other psychological phenomena (Gopnik and Wellman, 1992). In response, Harris (1991) has proposed a version of simulation theory which states that the child's access to some of their own psychological states may develop before others. For example, a young three-year-old may have a personal model of desire and perception, but not belief. Harris' (1991) proposal weakens the distinction between simulation theory and theory theory, although simulation theory can still be empirically distinguished from theory theory by the claim that the young child's inability to understand the psychological states of others is due to a deficit of counterfactual reasoning ability, which is described below.

If simulation theory is true, then children should be able to report their own mental states with greater accuracy than those of other people. This is apparently not the case. Young children do not appear to exhibit the knowledge of their own psychological states which simulation theory predicts that they should have. For example, three-year-old children often have difficulty reporting their former false beliefs (Gopnik and Astington, 1988) or desires (Gopnik and Slaughter, 1989), they are unaware of their own learning (Taylor, Esbensen, and Bennett, 1994), and they cannot identify the source of their own knowledge or beliefs (Gopnik and Graf, 1988; Povinelli and deBlois, 1992).

Gopnik and Slaughter (1991) found that three-year-old children are in fact quite capable of reporting their current psychological states, although incapable of reporting past psychological states. It is conceivable that children can give reports of their current mental states without any understanding of Intentionality, reporting instead what they

perceive to be the objective state of the world. However, three-year-olds are able to correctly report a current pretence, which is not a reading of the world 'as it is' (Harris, 1993), and are aware that thinking is not a transparent representation of current reality. For example, three-year-olds understand that a boy who is thinking about a dog may not see or touch the dog (Wellman and Estes, 1986).

The theory theory account of three-year-old children's failure on the false belief and representational change tasks is that the child's theory of mind is not adequately developed, and does not include an appreciation of belief (Gopnik, 1993). Harris (1993), however, suggests that those children who fail the false belief task are not doing so because they lack an appreciation of belief, but because they are using the simulation process inaccurately - the simulation is going wrong because current first-hand experience of the situation is not "overwritten". This first-hand experience is the child's "default setting", and each adjustment of the default setting requires a step of counterfactual ("what if") reasoning. The more counterfactual steps that are required to simulate a psychological state, the harder the simulation will be to execute (Harris, 1991). For example, understanding one's own current belief requires no counterfactual reasoning and should therefore always be possible. To imagine (simulate) the belief of another person (or one's own remembered self) requires one counterfactual step. To simulate the false belief of another person requires two counterfactual steps.

Harris (1991, 1993) suggests that a deficit of counterfactual reasoning, which leads to a constant inability to see beyond the "default setting" of present reality, is the key problem in young children and individuals with autism who fail the false belief and representational change tasks. There may be some evidence, in the rigid, stereotyped behaviour of some autistic individuals, for the claim that the ability to understand other

minds is reliant upon the power to temporarily alter such "default settings"; flexible planning requires a lot of counterfactual reasoning. Perner, Baker, and Hutton (1994) regard children's ability to pretend as demonstrating an impressive ability to understand counterfactuals. Autistic children are frequently unable to pretend-play or understand pretence (Baron-Cohen, 1995; Baron-Cohen & Bolton, 1993).

Spontaneous pretence can be seen in normal children as early as twelve months, and by three or four years many children create elaborate fantasies involving imaginary people and animals (Singer & Singer, 1990; Taylor, Cartwright, & Carlson, 1993). If even very young children are capable of the counterfactual reasoning required for pretence, then a counterfactual reasoning deficit cannot be the cause of their failure on false belief and representational change tasks. Harris concedes that if very young children were capable of pretence which required the same degree of counterfactual ability as the false belief and representational change tasks, then a counterfactual deficit could not account for the children's inability to succeed on those tasks. Children's pretence, however, undergoes a process of elaboration between 12 and 48 months of age, and Harris claims that the level of counterfactual ability required to pass a false belief or representational change test is not evident in children's pretence until they are of the approximate age that children tend to be able to pass those tests (Harris, 1991). Evidence regarding Harris' claims could be acquired by observing young children and children with autism (who have failed false belief and representational change tasks) to see whether they can evidence the ability to do counterfactual reasoning without using mentalistic concepts. For example, researchers could observe the children's play, and see if objects are ever substituted for imaginary things (e.g. a rock 'becomes' a spaceship). If the subjects evidence counterfactual reasoning, then a counterfactual

reasoning deficit could not be the cause of their previous false belief / representational change failure, and Harris' claim would be proven false.

No matter what difficulties young children have in understanding the psychological states of others, simulation theory presupposes that children should not be systematically wrong about their own psychological states (Gopnik and Wellman, 1992). Gopnik and Wellman claim that the evidence presented is therefore incompatible with simulation theory. Harris (1991) criticises the conclusions of Gopnik and Wellman (1992) on the grounds that it is just as hard to simulate one's own past false beliefs as it is to simulate the current false beliefs of another person (see part three of the discussion).

Empirical studies (Gopnik and Wellman, 1992) have shown that three-year-old children have a well-developed understanding of psychological states such as desires and perceptions, but not beliefs. Young children can report desires and perceptions that are just immediately past. The poor performance for beliefs therefore cannot be simply a problem of poor memory or lost access. These results appear to contradict the simulation theory, because the child should either be able or unable to model their own psychological states: not able to model some states and not others. The evidence appears to present a paradox for simulation theory: If reporting immediately past states requires simulation, then three-year-olds are able to simulate their past desires or perceptions, but not their past beliefs (which rules out a simple deficit of counterfactual reasoning ability). If reporting past states does not require simulation, because the states are just 'read off' the child's internal model, then the three-year-olds should not have the the trouble they do simply 'reading off' their past beliefs (Gopnik and Wellman, 1992, p.163).

In summary, the central issue when comparing the theory theory and simulation theory is the developmental status of self-knowledge. Theory theory claims that the child (and therefore, the adult) has no 'privileged access' to the nature of their own psychological states, while simulation theory claims that first-person phenomenological experience provides an intuitive understanding of one's own psychological states. As is stated by Gopnik and Wellman (1992), the issue is an empirical one, and it is the aim of the present study to contribute to the empirical investigation of this issue.

To summarise, part one discussed the evidence from autism for the existence of a neurological substrate of the ability to understand psychological states. The evidence strongly suggests the existence of a neurological module which is damaged in autistic individuals. I then compared and discussed four candidates for the specific function of that module: the metarepresentation module, social intelligence module, simulation module, and theory of mind module. Leekam and Perner (1991) demonstrated that young children are capable of representing non-mental representations, which ruled out a module responsible for all metarepresentation processing. It is possible that a module which processes only mental metarepresentation information exists in the human brain. The social intelligence module described by Happe and Frith (1992) appears to be nothing more than a theory of mind module by another name. Empirical evidence supports the possibilities of both a simulation module and a theory of mind module, depending upon the interpretation of that evidence. Simulation theory and theory theory can be distinguished empirically, and further testing is required to find results which will eliminate one of the two candidates. Part three of the introduction raises the possibility of the existence of a "first-person theory of mind module" which incorporates elements of the theory of mind module and the simulation module.

PART TWO: DEVELOPMENT OF THE THEORY OF MIND

I will discuss the development of the child's theory of mind in three sections. The first section is concerned with the first three years of the child's life, the second section describes the theory of mind at three years of age, and the final section considers the understanding that older children have of psychological states.

The first three years.

Children with autism and certain animals are not the only beings that seem to lack understanding of mental states. Very young children also lack this understanding (Gopnik and Astington, 1988; Wellman, 1990; Wimmer and Hartl, 1991). Developmental evidence supports the view that the child's comprehension of intentional states in themselves and others develops over the first years of the child's life, and that increasingly complex concepts such as belief and false belief are among the last to be included in the child's repertoire (Baron-Cohen, 1995; Chandler and Hala, 1994; Fodor, 1992; Gopnik, 1993; Gopnik and Astington, 1988; Harris, 1993). In this section I will discuss infants' early social referencing and joint attention abilities, and their understanding of phenomena such as desire and pretence.

Intentional communication, joint attention, and social referencing.

The rapid development of social cognitive ability in the first three years of the child's life is comparable to early linguistic development (Wellman, 1993). Just as researchers have investigated the possible existence of neural mechanisms which

facilitate linguistic development, the existence of a theory of mind module or equivalent neural mechanism is often posited to explain the rapid development of the infant's understanding of perceptual and mental states (Fodor, 1987; Hobson, 1991; Leslie, 1987). Children with autism usually fail to develop joint attention behaviours (Baron-Cohen, 1989; Sigman et al. 1986). Baron-Cohen (1995) describes the infant's early development of social referencing and joint attention skills as early steps in the development of a theory of mind.

Theory of mind development may begin with the newborn infant's natural ability to imitate the facial expressions of other people. The ability to imitate facial expressions provides a basis for social cognition because it allows the infant to immediately understand the correspondence between themselves and other people (Meltzoff and Gopnik, 1993).

As the infant matures, social cognitive skills develop which demonstrate some degree of Intentionality. Intentionality is a property of all mental states; that they refer to some content (Gopnik, 1993). For example, thoughts are intentional mental states because one cannot have a thought without having a thought *about* something. After approximately nine months of age intentional abilities such as social referencing, joint attention, and imitation of novel actions begin to appear (Adamson & Bakeman, 1985; Bakeman & Adamson, 1984; Bates, 1979; Bretherton, Bates, McNew, Shore, Williamson, & Beeghly-Smith, 1981; Lempers, Flavell, & Flavell, 1977; Stern, 1985; Trevarthen & Hubley, 1978). Joint attention is the ability to follow another person's gaze in order to see what they are looking at, and social referencing is the ability of the infant to monitor the caregiver's facial expression in order to understand how to react to a novel event (Baron-Cohen, 1991). Social referencing and joint attention abilities are

often considered precursors of theory of mind in humans or evidence for the existence of a theory of mind in some animals (Baron-Cohen, 1991; Baron-Cohen, 1995; Cheney & Seyfarth, 1991; Cheney & Seyfarth, 1992). Social referencing and joint attention skills evidence some degree of psychological state understanding because they refer to the behavioural consequences of psychological states, such as looking or moving. Although the infant probably does not explicitly understand anything of psychological states, they are effectively taking psychological states into account in their limited understanding of the behavioural consequences of those states.

At twelve months infants will modify their behaviour in response to their mother's emotional reaction (Baldwin, Moses, and Tidball, 1995; Feiring, Lewis, & Starr, 1984; Walden and Ogan, 1988). Joint attention is present in infants between eleven and fourteen months of age (Scaife and Bruner, 1975). By fourteen months the child is capable of producing and comprehending communicative gestures, such as pointing at a desired toy (Lempers, Flavell, & Flavell, 1977; Leung and Rheingold, 1981; Murphy, 1978), and infants of this age will check to see that the person to whom they are attempting to communicate has followed their point (Bretherton et al. 1981).

Bretherton (1991) claims that infant's early communicative skills take into account the intentional nature of other people. For example, fourteen month old infants will produce communicative gestures, and if these are not responded to by a partner the infant will often reproduce the gesture, possibly increasing its intensity (Bates, 1979). Bretherton (1991) argues that preverbal 'intentional communication' is evidence that infants attribute mental states to themselves and others, and that the infants understand that the behaviour of others can be influenced by signals.

Other theorists (Baldwin & Moses, 1994; Butterworth, 1991; Dennett, 1987; Perner, 1991) have suggested that it is possible for intentional action to be undertaken without the intentional agent having any understanding of their own intentional states. In the same manner that preverbal infants may attempt 'intentional communication' without an actual understanding of their own intentional states, they may also understand the responsive nature of communicative partners in a behaviourist fashion (Golinkoff, Harding, Carlson, & Sexton, 1984). As is the case with joint attention and social referencing skills, any infant that understands the behavioural consequences of psychological states should be considered to have at least a basic, implicit understanding of those states.

Desire.

Before young children develop an understanding of the representational nature of belief or false belief, they first develop an understanding of desire (Lillard & Flavell, 1992). Bartsch and Wellman (1995) demonstrated that even two year olds understand that people can differ in their desires and that the same object can be desirable to one person and undesirable to another. By two years of age children refer to their own mental states and those of others while talking about their own desires (Bartsch and Wellman, 1989, 1995).

Searle (1984) draws a distinction between psychological states with a "world to mind" direction of fit (e.g. desire) and a "mind to world" direction of fit (e.g. belief). Desire has a "world to mind" fit because *the world changes to fit the mind/desire.* Belief has a "mind to world" fit because *the mind/belief changes to fit the world.* Psychological states with a "world to mind" direction of fit may be easier to understand

because the physical world must be understood to change in response to the state, but there is no need for the child to understand that a psychological state might change to correspond with the physical world (Johnson, 1988; Perner, 1991). Young children may find desire easier to understand than belief because there is no possibility of misrepresentation in desire; there is no concept of "false desire" for the child to understand (Perner, 1991).

Astington and Gopnik (1991) claim that children initially have a mentalistic, but non-representational, theory of mind. Children with a mentalistic, non-representational theory of mind would only have an understanding of psychological states with a world to mind fit, such as desire. All mind to world fit psychological states represent the world in a particular way, and can change to 'fit' the world. Children's initial development of such a mentalistic, non-representational theory would explain the child's development of an understanding of desire and intention before belief, because children would understand the non-representational *world to mind fit* aspects of mental states before the representational ones. A contributing factor, or even an alternative explanation, is that desire may be understood at an earlier age due to the relatively high intensity of phenomenological experience which often accompanies it (Pillow, 1988).

Pretence.

Infants as young as twelve months often demonstrate examples of spontaneous pretence, and by three or four years of age many children frequently engage in elaborate pretence (Singer & Singer, 1990; Taylor, Cartwright, & Carlson, 1993). At two years of age children can understand, and act in accordance with the pretences of others (Harris & Kavanaugh, 1993; Harris, Kavanaugh, & Meredith, 1994). The capacity for pretend-

play may be evidence of metarepresentation and counterfactual reasoning abilities in young infants, which suggests that pretence is conceptually related to the later development of the child's understanding of belief and false belief (Harris, 1991; Leslie, 1987, 1988). Fodor (1992) claims that some understanding of false belief is necessary for pretence, but Harris (1991) argues that only a certain degree of counterfactual reasoning ability is required. Regardless of whether any understanding of false belief is necessary for pretence, the apparent necessity of counterfactual reasoning suggests that pretence may be an important stepping-stone on the child's path toward a fully developed understanding of psychological states.

Lillard (1994) claims that many activities which researchers often consider to be pretend play (e.g. jumping 'like a kangaroo') do not require pretence, but are understood by the child as a simple social activity. While very young children have been demonstrated as being capable of pretence (e.g. Singer & Singer, 1990), most four-year-olds (and many five year olds) tend to define pretence in behavioural terms; that a person is pretending when they are acting appropriately (e.g. jumping like a kangaroo), even if the person is not thinking about the object of pretence (in this case, kangaroos). If young children understand pretence in behavioural terms only, then the child's understanding of pretence does not provide evidence for an early understanding of intentional or representational states.

To summarise, during the first three years of the child's life, skills develop which appear to provide the basis for the later development of an understanding of psychological states. Joint attention and social referencing behaviours may represent the beginnings of the development of a theory of mind (Baron-Cohen, 1991; Baron-Cohen, 1995). The child's understanding of desire and pretence which develops during

the second and third years is often described by theory theorists as an early theory of mind, or causal explanatory framework, which will later incorporate representational concepts such as belief and intention (Gopnik and Wellman, 1994). The three-year-old child, who begins to evidence some understanding of representational states such as belief, is discussed in the next section.

The three-year-old child.

Three-year-olds already prefer mentalistic descriptions of events to behaviourist ones (Lillard and Flavell, 1990) and talk about mental states (Bartsch and Wellman, 1995; Shatz, Wellman, and Silber, 1983). In this section I will discuss evidence for the development of three-year-olds' understanding of belief and false belief, perspective taking, knowledge, and intention.

Belief and false belief.

Most research in the theory of mind literature is concerned with the acquisition of the child's concept of false belief (e.g. Baron-Cohen, Leslie, and Frith, 1985; Bartsch and Wellman, 1989; Chandler and Hala, 1994; Dunn, 1991; Dunn and Munn, 1985; Gopnik, 1993; Gopnik and Astington, 1988; Leslie, 1987; Lewis, 1994; Perner, Leekam, and Wimmer, 1987; Reddy, 1991; Siegal and Beattie, 1990; Wellman, 1990; Wimmer and Perner, 1983; Zaitchik, 1991). The general consensus is that at three years of age most children fail false belief and representational change tests, but mastery will be reached by five years of age. In the false belief test, the child witnesses a scenario in which a character will have a false belief about a particular situation (e.g. the location of

an object) and the child is then asked what the character believes. In order to pass the test, the child must state what the character's false belief is. In the representational change test, the child is put in a situation in which their own psychological state (such as a belief) changes, and the child is then asked what their original state was. In order to pass the test, the child must successfully report the original state. Gopnik (1993) and Wellman (1990) claim that a child that does not understand that beliefs can be false does not have a full understanding of belief. In part four of the introduction I will discuss the conceptual justification of the false belief and representational change tasks in the present study.

There are two major versions of the false belief task (Baron-Cohen, Leslie, & Frith, 1985; Perner, Leekam, & Wimmer, 1987; Wimmer & Perner, 1983). In the "unexpected location" task, a child witnesses an object being placed in a particular location by a puppet, who then leaves the area. Then the object is moved (hidden), and the puppet returns. The child is asked where the puppet will search for the object. In order to succeed on the task, the child must take the puppet's false belief into account and answer that the puppet will search in the object's old location (where the puppet 'thinks' it is). The "unexpected contents" task involves a familiar container being presented to the child, which is then shown to have unexpected contents. Most three-year-old children predict that another person would think that the unexpected contents are in the container, and thus fail to demonstrate an understanding of false belief in others (Perner, Leekam, & Wimmer, 1987).

The representational change task (Freeman & Lacohee, 1995; Gopnik & Astington, 1988; Wimmer & Hartl, 1991) is designed to demonstrate a child's ability (or inability) to understand that beliefs can not only be false, but that they can change.

Gopnik and Astington (1988) showed young children (three, four, and five years) a deceptive object and asked each child what they thought the object was when they first saw it. The children found the false belief task easier to pass than the representational change task, and the ability to succeed on the representational change task appeared to develop at approximately four years of age.

Three-year-olds rarely succeed on the false belief task, and mastery is usually reached by five years of age (Wimmer and Perner, 1983). The results of false belief studies have been replicated many times (Moses and Chandler, 1992). Theorists (Chandler, 1988; Gopnik and Wellman, 1994; Harris, 1991, 1993; Wellman, 1990) frequently debate claims that there is a developmental 'shift' to a representational theory of mind at three years of age, which allows four year olds to pass the false belief test which three-year-olds cannot.

Evidence is accumulating, however, that children who fail the standard false belief task do not do so necessarily because of a lack of understanding of false belief (e.g. Siegal & Beattie, 1991). For example, three-year-olds show improved performance on false belief tasks if the salience of the true state of affairs is reduced (Zaitchik, 1991). Performance is also enhanced if children are helped with the memory requirements of the task (Mitchell & Lacohee, 1991) and if the experimenter goes over the sequence of events in the false belief story twice before asking the test question (Lewis, 1994). Chandler and Hala (1994) showed that personal involvement of the child in setting up the "scene" in the false belief task also enhances performance.

Although the standard false belief task reveals the difficulties three-year-old children have in predicting behaviour based on false belief, three-year-olds are able to explain behaviours in terms of false belief after the event (Bartsch & Wellman, 1989;

Wellman, 1990). Children as young as two years spontaneously carry out deceptive acts and seem to be aware of the false beliefs their acts cause in others (e.g. Dunn, 1991; Dunn & Munn, 1985; Reddy, 1991). The evidence described above may challenge the concept of a 'watershed age' in theory of mind development or a 'developmental shift', but it is also possible that there is a developmental shift to a representational theory of mind, and that the evidence only lowers the age at which the shift is thought to occur.

Theory of mind researchers disagree as to whether the three-year-old child has a concept of representation. Woolley and Wellman (1993) have proposed that three-year-olds have some understanding of representational mental states, but that they often confuse the extent to which such states represent the physical world and state that imaginary representations truthfully reflect reality. Perner (1988, 1991) argues that three-year-old children are 'situation theorists' who have a non-representational understanding of the relationships between people and the world, and that four-year-old children become 'meta representers' (i.e. four-year-old children have a representational theory of mind). Other theorists (Astington & Gopnik, 1991; Flavell, 1988; Forguson & Gopnik, 1988) also consider the three-year-old child to have a non-representational theory of mind. Astington and Gopnik (1991) describe the three-year-old's theory of mind as mentalistic, but non-representational. Wellman (1990; and see Chandler, 1988, for a similar view) claims that three-year-olds do have a concept of representation, but that they have yet to develop an *interpretivist* understanding. An interpretivist understanding of the representational nature of mental states includes the notion of a mind which actively mediates and distorts the perception of reality. It is not clear whether there can yet be any resolution of the 'developmental shift' issue. Although it is an empirical question whether there is a developmental shift from a non-

representational to representational understanding of psychological states, the larger issue is not so easily resolved. The larger issue is whether the proposed developmental shift from non-representational to representational understanding is singularly important, or if it is only one in a series of important developmental milestones, such as the early development of joint attention and social referencing skills.

Perspective taking and knowledge.

By three years of age children are usually able to understand and report what other people can and cannot see from a particular physical vantage point, which has been labelled "level 1 perspective taking". Three-year-old children have difficulties, however, in understanding how something looks to another person, which is called "level 2 perspective taking" (Flavell, 1978; Lempers, Flavell, & Flavell, 1977; Masangkay, McKloskey, Sims-Knight, Vaughn, & Flavell, 1974). Gopnik, Slaughter, and Meltzoff (1994) have demonstrated that three-year-olds understand perceptual misrepresentation better than false belief. Gopnik et al. claim that mental representations are causally related to world events (a "mind to world" direction of fit), and that children first learn this in the context of perception.

Wellman and Bartsch (1988) claim that three-year-olds can appropriately infer the presence or absence of belief given information as to a character's seeing or not seeing a relevant situation. Three-year-olds do however appear to have difficulties explaining what other people do or do not know by making reference to perceptual access (Perner & Ogden, 1988; Taylor, 1988). Most three-year-olds and some four-year-olds cannot reliably assess whether another person knows what is in a box as a function of whether the person has looked inside (Pillow, 1989; Pratt & Bryant, 1990; Ruffman & Olson,

1989; Wimmer, Hogrefe, & Perner, 1988; Woolley, 1991). Three-year-old children also have difficulties identifying the source of their knowledge (Gopnik & Graf, 1988), the types of knowledge which can be acquired through particular sensory modalities (O'Neill, Astington, & Flavell, 1992; O'Neill & Gopnik, 1991), and the amount of time elapsed since knowledge was acquired. Four and five year old children will still claim that they have always known novel information which had just been taught to them by an experimenter (Taylor, Esbensen, and Bennett, 1994). Wimmer, Hogrefe, and Sodian (1988) have tried to account for these difficulties by proposing that there are two stages in the development of the child's theory of mind. The first stage begins in the second year of the child's life, in which children first become aware of thoughts and desires as mental states. The second stage, which begins to become evident in five year old children, is characterised by the child's ability to understand the informational origins of their knowledge. Wimmer et al. claim that the ability to understand the sources of one's knowledge is intrinsic to the child's ability to understand how they might come to hold a false belief.

Intention.

Two year old children often use language which suggests an understanding of intention or goal-directed behaviour (Dunn, 1991; Frye, 1991; Piaget, 1952; Willats, 1984). An example of such language might be; "Sarah is going to *(i.e. intends to)* run away". The term 'intention' should not be confused with Intentionality, which refers to a property of all mental states (that is, that they refer to or represent an external content).

Moses (1993) claims that intention and belief are co-dependent to the degree that it is difficult to imagine an intention existing without a related belief, and that intention

therefore could not be fully understood by children before they understand belief. Moses found that three-year-old children could accurately report a person's unfulfilled intentions and showed considerable understanding of that person's accompanying false beliefs. Wellman and Bartsch (1988) claim that even young three-year-olds understand that information about beliefs is a necessary addition to information about desires to explain or predict actions, and can predict the appropriate emotional reaction to the outcomes of belief-desire caused actions. Evidence from these investigations contradicts the view held by Perner (1991): that three-year-old children have a non-representational understanding of intention. Evidence from the child's understanding of belief (e.g. Chandler & Hala, 1994) which appears to push back the age at which young children understand the intentional or representational nature of mental states, also reduces the credibility of arguments that there is a watershed age before which children do not understand representation at all (e.g. Flavell et al., 1993). Instead, the child appears to develop an increasingly complex repertoire of explanatory constructs (sometimes called a causal explanatory network or reasoning scheme) such as desire, perception, and belief, which is used to explain the behaviour of intentional agents, such as humans.

In summary, attempts to describe a 'watershed' period of theory of mind development tend to focus upon three and four-year-old children (e.g. Gopnik, 1993; Perner, 1991). One of the more common 'developmental shifts' described by theorists such as Perner and Gopnik is the point at which the young child is said to acquire a representational theory of mind. The "false belief watershed" (the point at which the young child develops an understanding of false belief) is a developmental milestone which is being attributed to younger and younger children (Bartsch & Wellman, 1989;

Chandler & Hala, 1994; Dunn, 1991; Dunn & Munn, 1985; Reddy, 1991; Wellman, 1990). Theorists such as Chandler and Hala (1994) who "chase" the earliest point at which the child evidences a representational theory of mind may be missing the point, that the development of the theory of mind is characterised by a succession of milestones - new skills that, no matter how simple, pave the way for an adult understanding of psychological states.

The evidence discussed in this section tends to support the view that there is no specific developmental period or 'watershed' at which the child develops a representational theory of mind. Early joint attention and social referencing behaviours, and a later understanding of desire and pretence may be early developments of a theory of mind which is gradually constructed, without any sudden 'developmental shift'. The ability of three-year-old children to comprehend intention, which is arguably dependent upon belief (Moses, 1993), is another point against the concept of three-year-old children who do not understand the representational nature of psychological states. Theorists such as Freeman and Lacohee (1995) and Lillard and Flavell (1992) describe the development of the child's theory of mind as a continuous process of constructing and perfecting explanatory devices to understand human behaviour. The process of theory of mind development does not stop at age three (Wellman, 1990), and the further developments are discussed in the next section.

Later development.

The child's understanding of the representational nature of belief and false belief which begins to become apparent in three-year-old children, may be a necessary

precursor to later understanding of the mind as an entity which mediates and distorts the perception of reality (Flavell et al., 1993; Wellman, 1990).

Before six years of age, the child is apparently unable to understand that another person who shares their perceptual perspective may not be able to identify an object if the other person does not have the same prior knowledge of the object (Taylor, 1988). Taylor interpreted her results as supporting Chandler and Boyes' (1982) position that young children have a 'copy theory of mind'. A copy theory of mind is one in which the child conceives of the mind as a passive recorder or copier of incoming information (Chandler & Boyes, 1982; Flavell, 1988; Wellman, 1988). Other theorists disagree with Taylor's interpretation of the data, claiming instead that many three-year-old children and most four-year-olds demonstrate an understanding of the mind as an active information processor (Flavell, 1988; Perner & Davies, 1991).

Even eight year olds have difficulty understanding that the mind influences what one can know from verbal messages. For example, eight year old children think that a preverbal baby will understand a message spoken by an adult (Montgomery, 1991, 1992; Taylor, Cartwright, & Bowden, 1991). At approximately age six children begin to understand the sources of their knowledge (O'Neill & Gopnik, 1991), and that knowledge can be arrived at by inference (Flavell et al., 1993). Pillow (1991) demonstrated that at approximately six years of age children are capable of understanding that people can have a biased interpretation of another person's behaviour.

Wellman (1990) claims that after six years of age, the child's theory of mind develops in two important ways; the development of specific theories and natural epistemology. Specific theories are part of the greater 'theory of mind framework', and

are used to explain such phenomena as the self, intelligence, and memory. For example, the developing self theory is a constructed understanding of one's own "..beliefs, desires, traits, history of perceptions, and memories" (Wellman, 1990, p.298). The child's understanding of the nature of intelligence appears to develop after age six (Dweck & Bempechat, 1983; Dweck & Leggett, 1988; Sternberg, Conway, Ketron, and Bernstein, 1981; Yussen & Kane, 1985), as does their understanding of memory (Beal, 1985; Fabricius & Wellman, 1983; Flavell, 1971; Flavell & Wellman, 1977; Gordon & Flavell, 1977; Herrmann, 1982; Johnson & Wellman, 1982; Kreutzer, Leonard, & Flavell, 1975; Schneider, 1985; Wellman, 1983). Wellman (1990) claims that after age six children develop a 'constructivist epistemology', as opposed to an absolutist or objectivist epistemology. An objectivist epistemology describes the world as being one way; that there is a single, objective truth of every matter. A constructivist epistemology describes truth as relative, that "... persons may find *legitimately* different meanings in what are ostensibly the same facts" (Chandler, 1987, p.135).

Development of the child's understanding of intention, pretence, desire, belief, and other concepts described earlier does not appear to stop after four or five years of age. Wellman (1990) describes the later development of these concepts as a process of elaboration and consolidation. After six years of age children become increasingly adept at second order thinking; the ability to think about thoughts about thoughts (Miller, Kessel, & Flavell, 1970; Perner & Wimmer, 1985). The developing capacity for second order thinking can also be described as an increase in the capacity for the metarepresentation of mental representations. Older children are also capable of increasingly sophisticated discussion about appearance-reality phenomena (that what an object appears to be may not be what it actually is) and the phenomenon of

misinterpretation in visual representations (Flavell et al., 1986). After six years of age children begin to demonstrate an explicit understanding that the mind may be defined in terms of mental states (psychology), while the brain is the subject of biology - defined as it is in terms of neurological states (Johnson & Wellman, 1982). Once the child has come to understand that a distinction may be made between the mind and brain, they may begin a life-long period of attempting to develop an understanding of how to reintegrate the two.

To summarise part two of the introduction, the first three years of the child's life are filled with the development of skills which, in themselves, do not appear to evidence explicit understanding of psychological states, but which refer to the behavioural consequences of psychological states. Early skills such as joint attention and social referencing are important milestones which pave the way for later development of the child's theory of mind. At three years of age children begin to evidence an understanding of belief, perspective taking, knowledge, and intention. After three years of age the child consolidates and elaborates their earlier understanding of psychological states, and begins to understand the mind as an active processor of one's perceptions rather than a passive receptacle.

PART THREE: FIRST-PERSON THEORY THEORY

Part three is divided into three sections. In the first section I will discuss the developmental priority of self knowledge. Gopnik (1993) states the the child's theory of mind is applied simultaneously to self and other, while simulation theorists such as Harris (1991) claim that people have a direct, phenomenological understanding of their own psychological states which is superior to their understanding of other people's psychological states. Self knowledge is a crucial issue in distinguishing empirically between theory theory and simulation theory.

In the second section I will propose a role for psychological experience in theory of mind development. Gopnik (1993) is careful to make the distinction between psychological experience (or the "stream of consciousness") and psychological states, but she does not suggest any role that psychological experience might play in theory of mind development.

In the third section I will present my "first-person theory theory". First-person theory theory states that the child develops a theory of mind which is first used to explain the child's own behaviour, and is only later applied to the behaviour of others. First-person theory theory also proposes a role for psychological experience in theory of mind development. The issues of developmental priority of self knowledge and whether the child's understanding of psychological states is theoretical have become confused in the literature (e.g. Moses & Chandler, 1992). The value of first-person theory theory is that it makes clear the distinction between the two issues by demonstrating that it is possible that self knowledge could be theorised by the young child, and yet still have developmental priority.

Self knowledge.

In this section I will discuss the nature of the child's understanding of their own psychological states in relation to their understanding of the psychological states of others. Gopnik (1993) draws a distinction between psychological experience and psychological states. Psychological experience is described as being the conscious experience or phenomenology described by Joyce or Woolfe, the 'stream of consciousness' and accompanying qualia often reported by normal humans. Psychological (or mental) states are described as being the underlying entities that explain our behaviour and experience, such as beliefs and desires. Simulation theory does not make a distinction between psychological states and psychological experience (Gopnik, 1993).

Flavell, Green, and Flavell (1993) have found that children as old as four years tend to say that the mind of a waiting person is "not doing anything", whether that person is another individual or themselves, and that a person who wanted to could keep his or her "mind completely empty of all thoughts and ideas" for three minutes. Although the children in the study by Flavell et al. did not recognise the continuous nature of psychological experience (or 'stream of consciousness'), early intentional behaviours such as joint attention and social referencing suggest that even very young infants have a psychological experience (Flavell et al., 1993).

Gopnik (1993) claims that although we are aware of our own phenomenological experience we do not have a privileged first-person knowledge of our own psychological states. Common sense (as described by Gopnik) and simulation theory (Goldman, 1989, 1992; Gordon, 1986, 1992; Harris, 1989, 1991; Johnson, 1988) claim

that normal humans have a direct, intuitive understanding of the intentional nature of their own psychological states. People are said to note the behaviours which result from their own (directly known) psychological states, and when those same behaviours are produced by others the inference is made that the other person holds the same psychological state. In contrast, Gopnik (1993) explains our understanding of intentional states in ourselves and others in terms of the 'theory theory'. The theory theory states that the young child develops an implicit theory of mind, which explains the nature of the mental states that underlie human behaviour without any particular emphasis on one's own mental states. The child's theory of mind allows them no more understanding of their own psychological states than of similar states in other people (Gopnik, 1993; Gopnik & Wellman, 1992; Moses & Chandler, 1992).

If, as simulation theory proposes, young children have an intuitive understanding of their own psychological states, then the child would be expected to succeed on tasks which test that understanding (Gopnik, 1993). On the contrary, Gopnik and Astington (1988) found that one-half to two-thirds of the three-year-olds in their study failed to correctly answer questions about their previous false beliefs in an unexpected contents task (see p.67 for a description of the task). Gopnik and Astington's results have been replicated several times, and controls for memory and syntactic complexity of the questions have ruled out these explanations of the finding (Moore et al., 1990; Wimmer & Hartl, 1991). Gopnik and Astington also asked the children an additional control question, with the same syntactic structure as the test questions, which asked about a past physical state rather than a past mental state. Only children who passed this control question were included in the experiment.

Gopnik (1993) also argues that evidence that young children are unable to identify the source of their knowledge (Gopnik & Graf, 1988; O'Neill, Astington, & Flavell, 1992; O'Neill & Gopnik, 1991; Wimmer et al., 1988) is incongruent with the assertion by simulation theorists that children have privileged first-person knowledge of their own psychological states. Gopnik and Slaughter (1991) found that when three-year-old children were made aware that they were in one state (e.g. hungry) and then another (e.g. not hungry), a significant minority (30%-40%) reported that they had been in their final state the whole time. Half of a sample of children who were asked to complete a task (e.g. draw a ball with a red crayon) and were then interrupted before they could finish and asked to complete a different task (e.g. change the drawing to an apple) reported that they had originally intended to complete the second task. Gopnik (1993) claims that young children's difficulties in identifying past intentional states is evidence that they do not have an intuitive first-person knowledge of their own psychological states.

Harris (1993) argues against the validity of Gopnik's conclusions with two points. Harris' first criticism is that the evidence only shows that young children have difficulties in understanding the intentional nature of their own past beliefs, and that simulation theory need not claim that the child's past beliefs are directly accessible to first-person knowledge. If counterfactual reasoning is required to simulate the beliefs of another person or one's own false or past beliefs, then the young child's inability to identify their own past mental states can be explained in terms of a counterfactual reasoning (i.e. simulation) deficit. However, children as young as twelve months to two years of age demonstrate the capacity for pretence (Harris & Kavanaugh, 1993; Harris, Kavanaugh, & Meredith, 1994; Singer & Singer, 1990; Taylor, Cartwright, & Carlson,

1993), which appears to present a problem for Harris' claim that a counterfactual reasoning deficit is responsible for young children's inability to understand their own past false beliefs.

Harris (1993) cites an experiment by Zaitchik (1991) as evidence that young children who have difficulties with the false belief task may do so because of an inability to over-ride the default settings of present reality. Zaitchik has shown that when three-year-olds are not given first-hand experience of reality (e.g. the relocation of an object is described to them, but not actually shown) then their ability to succeed on the false belief task improves dramatically. Zaitchik's result, however, can also be explained by theory theory: It is quite reasonable to expect that although the child might understand false belief, they are simply distracted or confused by the high salience of the testing situation.

In summary, it is not immediately obvious whether theory theory or simulation theory provides a better explanation of development of the child's understanding of psychological states. Further empirical testing is needed to distinguish the two accounts. A third account which incorporates features of both theory theory and simulation theory, the "first-person theory theory", is presented in section three.

The role of psychological experience in theory development.

In this section I will consider the role of psychological experience in the development of the child's understanding of their own psychological states. Gopnik (1993), while careful to define the distinction between psychological experience and psychological states, does not suggest what role (if any) psychological experience may

play in the development of the child's theory of mind. While simulation theory suggests a very important role for phenomenology in facilitating the child's understanding of psychological states (allowing a direct, intuitive understanding of one's own states), theory theory invariably asserts that the the child has no such intuitive first-person knowledge (Gopnik, 1993; Moses & Chandler, 1992), and theory theorists do not suggest any role that psychological experience might play.

It is possible that once the young child becomes reflectively aware of their own phenomenological experience they begin to theorise about their own psychological states, and that the theories constructed by the child are soon applied to explain the behaviour of other people. If the child begins to construct a theory of mind after developing some awareness of their own psychological experience and the theory is first used to explain the child's own behaviour, then young children should evidence a greater understanding of their own psychological states than of the psychological states of others. Such a difference between the child's understanding of false belief in self and others may not be detectable by standard false belief tasks such as those used by Gopnik and Astington (1988). The child may indeed not have an understanding of false belief in others, and their understanding of their own false beliefs may only be demonstrable when the child has some degree of personal and cognitive involvement in the false belief scenario. If the child's awareness of their own psychological experience led them to theorise about their own psychological states, then current psychological experience may help the child to demonstrate their understanding of a particular psychological state.

Three-year-olds have significantly less difficulty with false belief tasks when the child has personal involvement in the deception of an assistant (Chandler & Hala,

1994). Chandler and Hala claim that the greater cognitive involvement of the child in the task reveals an understanding of false belief in three-year-olds that many theorists have previously denied (Flavell, 1988; Forguson & Gopnik, 1988; Leslie, 1988; Perner, 1988; Wimmer, Hogrefe, & Perner, 1988; Wimmer, Hogrefe, & Sodian, 1988). Chandler and Hala's (1994) findings support the present proposal, that heightened cognitive involvement highlights a greater understanding of false belief on the child's part because it is similar to the awareness of psychological experience which stimulates the child's theory of mind development. The second proposal of the present study is that heightened cognitive involvement will increase children's accuracy on questions about their own psychological states to a greater degree than it will increase accuracy on questions about the psychological states of others. Part four of the introduction describes the present study in which the two proposals are tested.

First-person theory theory.

There is a confusion in the literature (e.g. Moses & Chandler, 1992) between two issues. The first issue is whether the child's developing understanding of psychological states, both in themselves and others, is theoretical in nature. The second issue is whether the child's understanding of their own psychological states develops before their understanding of other people's psychological states. Theory theory (e.g. Gopnik, 1993) proposes that the child's understanding of psychological states is theoretical in nature, and that there is no developmental priority of self knowledge. Simulation theory (e.g. Harris, 1991) proposes that the child's understanding of psychological states is not theoretical in nature, and that self knowledge does have developmental priority. The

literature of theory theory and simulation theory tends to assume that all versions of theory theory will propose that there is no developmental priority of self knowledge, and that only simulation theory proposes that children understand their own psychological states before they understand such states in others. First-person theory theory is proposed by the present study in order to distinguish between these two issues, by describing a version of theory theory in which self knowledge of psychological states has developmental priority.

I have described the two elements which constitute the first-person theory theory in sections one and two. The first element of first-person theory theory is that the child's theory of mind is initially developed to explain the child's own behaviour, and is only later applied to the behaviour of others. The first element of first-person theory theory will be tested in the present study.

The second element of first-person theory theory is the proposed role of psychological experience or 'stream of consciousness' in theory of mind development. The child begins to theorise about their own psychological states after having first become reflectively aware of their own psychological experience. Later reflection upon the child's personal psychological experience in a situation which involves a particular psychological state will facilitate recall of the theorising process, and will thus enhance the child's ability to apply their theoretical understanding of that state to the situation. If this account is correct, then heightened cognitive involvement in a false belief or representational change test should facilitate the child's accuracy in answering test questions about their own beliefs to a greater degree than it would facilitate the child's accuracy in answering questions about other people's beliefs. This prediction of the first-person theory theory will be tested in the present study.

PART FOUR: THE PRESENT STUDY

First-person theory theory states that the young child develops a theory of mind which is first used to explain the child's own behaviour in terms of psychological states, and is later applied to the behaviour of others. First-person theory theory represents a compromise between 'hard' theory theory, which states that the child's theory of mind is applied to self and other simultaneously (Gopnik, 1993; Gopnik & Wellman, 1992; Moses & Chandler, 1992), and simulation theory, which states that the child has no need to develop a theory about anybody's behaviour - they can simply "read" an internal model of their own psychological states (Goldman, 1989, 1992; Gordon, 1986, 1992; Harris, 1989, 1991; Johnson, 1988).

The second element of first-person theory theory is the proposed role of awareness of personal psychological experience in theory of mind development. First-person theory theory states that the child's initial theorising (about their own psychological states) begins after they become reflectively aware of their own psychological experience or 'stream of consciousness'. If the child's awareness of their own psychological experience led them to theorise about their own psychological states, then the psychological experience which accompanies heightened cognitive involvement in a task (such as a representational change test) should help the child to demonstrate their understanding of their own psychological states to a greater degree than it helps them understand other people's psychological states.

Subjects in the present study were assigned to a participation group, or a non-participation group, and run through five experimental trials each. Subjects in the participation group would help move the props (e.g. hiding soap) and choose one of three props to replace the 'hidden' object with. Subjects in the non-participation group simply watched and answered questions.

Each subject was run through five trials of the experimental procedure, two of which were control trials (see method, p.). Each experimental trial consisted of two parts. The first part was a false belief test, in which the child was shown two containers (e.g. a covered soap dish and an icecream cone box), and one of the containers was empty, while the other had an appropriate object inside (in trial A the icecream cone box was empty, and the soap dish contained soap). While an assistant was out of the room, the contents of the second container were 'hidden' from the assistant in the first container. For example, in trial A the soap was put in the icecream cone box and one of three coloured balls was put in the soap dish. Subjects in the participation group helped the experimenter to hide the object, while non-participation subjects simply watched. The child was then asked *look* questions about where the assistant would look for the soap, and *think* questions about where the assistant would think the soap was. Control questions (see method, p.66) were asked at this point.

Once the assistant had returned and been 'surprised', the child was asked to put the hidden object (soap) back in it's original position. Shortly before this point, the assistant had used sleight of hand to replace the soap dish which contained a coloured ball with an identical one which contained soap. The child was surprised to see the (unexpected) soap when they opened the soap dish. The experimenter then asked *look*

questions about where the child had looked for the soap, and *think* questions about where they had thought the soap was.

The present study investigates five specific questions, all of which are discussed below. The first question tests the first proposal of first-person theory theory, that the young child understands their own psychological states before they understand the psychological states of others. The second question tests the second proposal of first-person theory theory, that the child's reflection upon their personal psychological experience during a false belief test will facilitate recall of the theorising process, and will thus enhance the child's ability to understand false belief, particularly their own false beliefs.

Do the subjects respond with greater accuracy to *self* questions or to *other* questions?

Gopnik (1993) reports that young children do not answer questions about their own false beliefs with any greater accuracy than they answer questions about other people's false beliefs, and concludes that the child's theory of mind is applied to self and other simultaneously. The present study attempts to replicate the results of Gopnik (1993). If subjects in the present study respond with equal accuracy to the *self* and *other* questions, then the results will be a successful replication of Gopnik's (1993) findings. If the present finding is that subjects respond with greater accuracy to the *self* questions than to the *other* questions, then the theoretical implication is that 'hard' theory theory of the type presented by Gopnik (1993) is wrong. The first-person theory theory

predicts that subjects will respond with greater accuracy to the *self* questions than to the *other* questions.

Do the subjects in the participation group respond to *self* questions with greater accuracy than to *other* questions?

The first-person theory theory (presented in part three of the introduction) predicts that the subjects in the participation group will respond to the *self* questions with greater accuracy than to the *other* questions. If the child's awareness of their own psychological experience causes them to begin theorising about their own psychological states, and the greater cognitive involvement / psychological experience of the participation subjects facilitates understanding of those psychological states, then subjects in the participation group should have their understanding of their own false beliefs facilitated to a greater degree than their understanding of other people's false beliefs.

If the present result is that participation group subjects respond to the *self* questions with greater accuracy than the *other* questions, then 'hard' theory theory (e.g. Gopnik, 1993) will have been shown to be incorrect, as 'hard' theory theory states that young children have no greater understanding of their own psychological states than they have of other people's psychological states. If the present result is that participation group subjects do not respond to the *self* questions with greater accuracy than to the *other* questions, then the second element of first-person theory theory (that awareness of one's own psychological experience initiates self-theorising) will have been disproved.

Do the subjects in the participation group respond to the test questions with greater accuracy than those in the non-participation group?

Chandler and Hala (1994) report that subjects who have some degree of personal involvement in the execution of the experimental task answer test questions with significantly greater accuracy than those subjects who have no such involvement. The present study attempts to replicate the findings of Chandler and Hala by comparing the accuracy of a participation group and a non-participation group. If subjects in the participation group respond to the test questions with greater accuracy than those in the non-participation group, then the result will be a successful replication of Chandler and Hala (1994). The implication of a successful replication of Chandler and Hala would be that even young three-year-olds understand the representational nature of false belief, but that traditional (non-participation) false belief and representational change tests fail to detect that understanding.

Do the subjects respond with greater accuracy to *look* questions or to *think* questions?

Chandler and Hala (1994) report that young children respond to test questions which ask where a certain person will *look* for an object with greater accuracy than they will answer questions which ask where the person will *think* an object is. The inclusion of *look* questions in the present study is an attempt to replicate Chandler and Hala's (1994) results. If subjects answer *look* questions with greater accuracy than *think* questions, then the present study will have replicated Chandler and Hala's (1994) finding.

Does accuracy in answering the test questions increase with age?

Theory theorists such as Gopnik (1993) and Wellman (1990) report findings that the ability to understand false belief develops in children at approximately four years of age, but it is not apparent whether all three years olds have equal difficulty in understanding false belief, or if older three-year-olds evidence a greater understanding of false belief than young three-year-olds. If accuracy in answering the test questions is found to be higher among older three-year-olds, the finding would support the conclusion that the child's understanding of false belief develops significantly between the third and fourth birthdays.

Methodological points.

Two methodological points are discussed below. The first is a discussion of whether theoretical criticisms of the false belief task are applicable to the present study. Second, the choice of present test and control questions is discussed.

The false belief task.

In part two of the introduction I described the debate in the theory of mind literature regarding whether the false belief task is a suitable method of ascertaining whether a young child has a representational theory of mind. Recently, several theorists have criticised the tendency in the theory of mind literature to describe the "developmental shift" from three to four years of age as a shift from a non-representational to a representational understanding of mental states (Chandler, 1988; Harris, 1993; Wellman, 1990). The present study uses false belief and representational

change tests because such tests apparently do highlight some kind of developmental milestone between three and four years of age. With regard to the present study, it is not important exactly what that milestone is; whether three-year-old children are just beginning to understand the representational nature of false belief, or are developing a different type of understanding of mind. What is important to the present study is that the false belief test measures the same understanding of other people's minds (when the child is asked about other people's beliefs) as the representational change test measures when children answer questions about their own past beliefs. There is only one reason to believe that the false belief test and representational change test may be measuring different types of understanding, and that is that in the false belief test the child is asked questions about the *current* false belief of another person, whereas in the representational change test the child is asked questions about their own *past* false belief. This "present other, past self" problem is discussed in part three of the discussion.

Question structure.

The question structure used in the present study is derived from the studies of Chandler and Hala (1994) and Gopnik and Astington (1988). In the test questions the children are asked where the assistant would *look* for the expected contents of a familiar container, and where the assistant would *think* the expected contents were (Chandler & Hala, 1994). Each question provides the child with two forced-choice alternatives (Gopnik & Astington, 1988). Each trial includes two control questions, the *memory* and *reality* questions (see method, p.67), both of which must be answered successfully if the trial is to be considered valid. The memory question controls for the possibility that the

child's answers are due to an inability to recall past events. The reality question controls for the possibility that the child's answers are due to confusion on the child's behalf regarding current reality. The structure of the control questions is taken directly from Gopnik and Astington (1988).

METHOD.

1. Subjects.

Forty eight children were recruited from Christchurch childcare centres with the written consent of each child's parent or guardian. Twenty of the original forty eight subjects failed control questions (see p.67) and were excluded from the study. Testing of subjects continued until a total of thirty six children had passed the control questions.

Subjects were randomly assigned to two groups, with age (in months) and the childcare centre attended by each child (which may influence socioeconomic status) balanced between groups. One of these groups was a 'participation' group which had personal involvement in the preparation of the experimental tasks. The other, 'non-participation', group was a control group which had no personal involvement in the preparation of the experimental tasks. The group, age, and suburb (of childcare centre) of each of the thirty six subjects are listed in table 1.

2. Materials.

The props used in each of the five experimental trials are listed in table 2. The props are listed in the same order for each trial, i.e., the two soap dishes are used for the same purpose in trial A as that for which the two weetbix boxes are used in trial B. The trial A props are used in the description of the experimental procedure.

Subject	Group	Age (in months)	suburb of childcare centre
1	E	43	Redcliffs
2	E	44	Redcliffs
3	E	38	Shirley
4	E	38	Shirley
5	E	43	Riccarton
6	E	36	Riccarton
7	E	44	Riccarton
8	E	42	Sydenham
9	E	42	Linwood
10	E	47	Dallington
11	E	39	Fendalton
12	E	45	Fendalton
13	E	45	Cashmere
14	E	45	Fendalton
15	E	41	Riccarton
16	E	38	City centre
17	E	44	Southshore
18	C	47	Shirley
19	C	46	Shirley
20	C	45	Shirley
21	C	42	Shirley
22	C	42	Ilam
23	C	42	Ilam
24	C	47	Ilam
25	C	41	Redcliffs
26	C	44	Addington
27	C	46	Linwood
28	C	39	Sydenham
29	C	39	Dallington
30	C	47	Dallington
31	C	40	Sydenham
32	C	43	Fendalton
33	C	43	Fendalton
34	C	45	Riccarton
35	C	38	Addington
36	C	43	Avonhead

Table 1. Table of thirty six subjects, their membership of either the participation group (E for experimental) or the non-participation group (C for control), age in months, and suburb of childcare centre attended.

Trial A	Trial B	Trial C
2 soap dishes	2 weetbix boxes	2 milo boxes
2 bars of soap	2 plastic bags of weetbix	2 packets of milo
icecream cone box	icecream container	soap pad box
3 coloured balls	3 small soft toys	3 coloured lollies

Control Trial 1	Control Trial 2
toothpaste box	biscuit packet
tube of toothpaste	1 biscuit
laundry powder box	tortilla chip box
3 coloured candles	3 pairs coloured glasses

Table 2. Props for the five trials used with each subject.

3. Procedure.

In this section I will briefly describe the experimental procedure, the three experimental manipulations, and the control trials. I will then describe the format of the experimental trials in detail.

Two people conducted the experiment, an experimenter and an assistant. The experimenter showed each subject an empty box and a box with appropriate contents. Once the assistant had left the room, the experimenter suggested to the child that the contents of one box be hidden from the third person in the other, empty box. The contents of the first box were replaced with a novel object. The subject was then asked questions about the third person's beliefs about the location of the boxes' contents. The

subject was also asked two control questions. The procedure up to this point is referred to hereafter as the *false belief component.* The third person then returned, feigned surprised at the locations of the various objects, and (using sleight of hand) replaced one of the boxes with a similar one that had contents which would be unexpected by the child. The child opened the box, was surprised by the contents, and was asked questions about their own previous beliefs about the box's contents. The second half of the procedure is referred to hereafter as the *representational change component.* The experimental procedure is described in detail below.

The abbreviations 'E1' and 'E2' used in the description of the present study refer to the 'first experimenter' and 'second experimenter'. In the present study, the first experimenter was male and the second experimenter was female. The first experimenter asked the subject all test and control questions, and recorded their responses. The second experimenter left the area when experimental props were moved about, feigned surprise upon discovering a prop's new location, and swapped props for the representational change test in each trial.

Person (self vs. other) manipulation.

The experimental procedure was run five times per subject, and each of the five trials had two parts, the false belief test and the representational change test. In the first part, the subject witnessed the deception of E2, and subsequently answered test questions which assessed their understanding of false belief in other people. In the second part, the subject was deceived, made aware of their own false belief, and asked test questions which assessed the subject's understanding of their own false beliefs.

Modality (look vs. think) manipulation.

Within each part of the experimental procedure, the subject was asked two test questions, the 'look' question and the 'think' question. Half the subjects were asked the 'look' question first, and half were asked the 'think' question first. One question assessed the subject's understanding of where the target had looked or would look (modality: sight), and the other question assessed the subject's understanding of where the target thought, or would think a particular object was located (modality: belief).

Personal involvement manipulation.

All subjects took part in the experimental exercise, and were asked the same questions, but subjects in the non-participation group had no personal role to play in the execution of the experimental task. E1 asked the subject to watch what E1 did, but the subject was not invited to help deceive E2 by (for example) choosing which of three coloured balls was to be placed in the soap dish once the soap has been removed (see *trial description*). Subjects in the participation group were asked, in each trial, to choose one of three props to replace an object which had been 'hidden' from E2. Test question order, order of forced choice alternatives within each question, and trial order were all counterbalanced within each subject group (see appendix A).

Control trials

Each subject was run through five trials. The five trials were labelled A, B, C, 1, and 2. Trials A, B, and C were normal examples of the experimental procedure described in the *trial description*, below. The order in which both the participation and non-participation groups underwent trials A, B, and C was balanced between subjects.

Trials 1 and 2 were control trials designed to prevent the children from coming to expect the surprise in the representational change component. There was no representational change component in the control trials. The order of the control trials was not balanced between subjects, which were always the third and fifth trials of the five.

Trial description

The experimental procedure was run five times per subject, and each of the five trials used a different set of props. Scripts for the five trial types in both the participation and non-participation groups are in appendix B. The experimental procedure for a single trial is summarised below. The props for trial A are used in the following description.

False belief questions.

Each subject was presented with two containers by the first experimenter (E1); a soap dish and an icecream cone box. The icecream cone box was opened and shown to be empty, and the soap dish was opened to reveal a bar of soap. At this point experimenter two (E2) expressed interest in the bar of soap, and E1 asked E2 to get him a pencil (rubber, ruler, etc.) before taking a closer look or smelling the soap. Once E2 had left the area, E1 invited the subject to help deceive E2 by hiding the soap in the icecream cone box, and replacing it with one of three coloured balls.

When the soap and coloured balls had been moved, E1 asked the subject two test questions: **(Qn.1) "Where will (E2) think the soap is? In the soap dish or in the icecream cone box?"** and **(Qn.2) "Where will (E2) look for the soap? In the soap dish or in the icecream cone box?"**. Both the order of questions within each pair

(Qn.1/Qn.2) and the order of forced choice alternatives within each question (soap dish/icecream cone box) were counterbalanced.

Control questions.

E1 then asked the subject two control questions. Although the order of alternatives within the control questions were alternated, the order of the questions themselves remained constant. The questions were: **(Qn.1) "When you first saw the soap, before we moved it, where was it? In the soap dish or in the icecream cone box?"** and **(Qn.2) "Where is the coloured ball now? In the soap dish or in the icecream cone box?"**.

The first control question (the *memory* question) was designed to confirm that the subject remembered enough information to successfully complete the task. The second question (the *reality* question) was designed to confirm that the subject was not confused about current reality. Failure to correctly answer either control question invalidated the trial.

Representational change questions.

After the subject had answered the control questions E2 entered the area, declared a desire to smell/look at the soap, and feigned surprise upon opening the soap dish - which now contained a coloured ball. While E1 briefly distracted the subject, E2 then discretely swapped the soap dish which contained a coloured ball for a second soap dish which contained a bar of soap. E1 then asked the subject to open the soap dish, and the child was (usually) surprised to see that there was soap in the dish rather than a coloured ball.

At this point E1 asked the subject two test questions: **(Qn.1) "Before you looked in the soap dish just now, where did you think the soap was? In the soap dish or in the icecream cone box?"** and **(Qn.2) "Where did you look for the coloured ball? In the soap dish or in the icecream cone box?"**. The order of these two test questions, and the order of the forced choice alternatives presented within the questions, was counterbalanced.

RESULTS

Twenty of the original forty eight subjects failed the control questions in all three experimental trials, and were thus excluded from the study. The mean age of those who failed the control questions was 41.3 months, while the mean age of those who passed was 42.6 months. The difference between the mean ages was not significant, t (46) = 1.38, ns. Testing of subjects continued until a total of thirty six children had passed the control questions in at least one experimental trial.

A Pearson product-moment correlation was performed on the overall performance score and age (in months) of each subject, and there was no significant correlation between age and accuracy, $r = .14$, df = 34, ns. Pearson product-moment correlations were performed between age and the false belief (*person*: other) and representational change (*person*: self) scores of each subject. Age did not correlate significantly with either false belief scores, $r = .08$, df = 34, ns, or representational change scores, $r = .13$, df = 34, ns.

A three-way ANOVA was performed on the percentage of test questions answered correctly, with two repeated measures factors and one between subjects factor. The first repeated measures factor was *modality of question.* There were two levels of the modality factor, 'look' (test questions regarding where E2 or the subject would look, or had looked for an object) and 'think' (test questions regarding where E2 or the subject would think, or had thought a particular object was). The second repeated measures factor was *person.* The person factor had two levels, 'self' (questions testing the child's understanding of their own beliefs) and 'other' (questions testing the child's understanding of E2's beliefs). The between-subjects factor was *group.* The group

factor had two levels, 'participation' (in which subjects participate by choosing which of three props to use in each trial) and 'non-participation' (in which subjects do not participate in the execution of the trials beyond answering questions).

The 'look' questions (variable: *modality*) were answered with significantly greater accuracy (m = 66.0) than the 'think' questions (m = 47.9), $F(1,34) = 8.44$, $p < .01$. Figure 1 shows the difference between the mean 'look' score and the mean 'think' score. The 'self' questions (variable: *person*) were also answered with significantly greater accuracy (m = 68.3) than the 'other' questions (m = 45.6), $F(1,34) = 7.94$, $p < .01$. Figure 2 shows the difference between the mean 'self' score and the mean 'other' score. There was no significant difference between the participation group (m = 57.4) and the non-participation group (m = 56.6), $F < 1$.

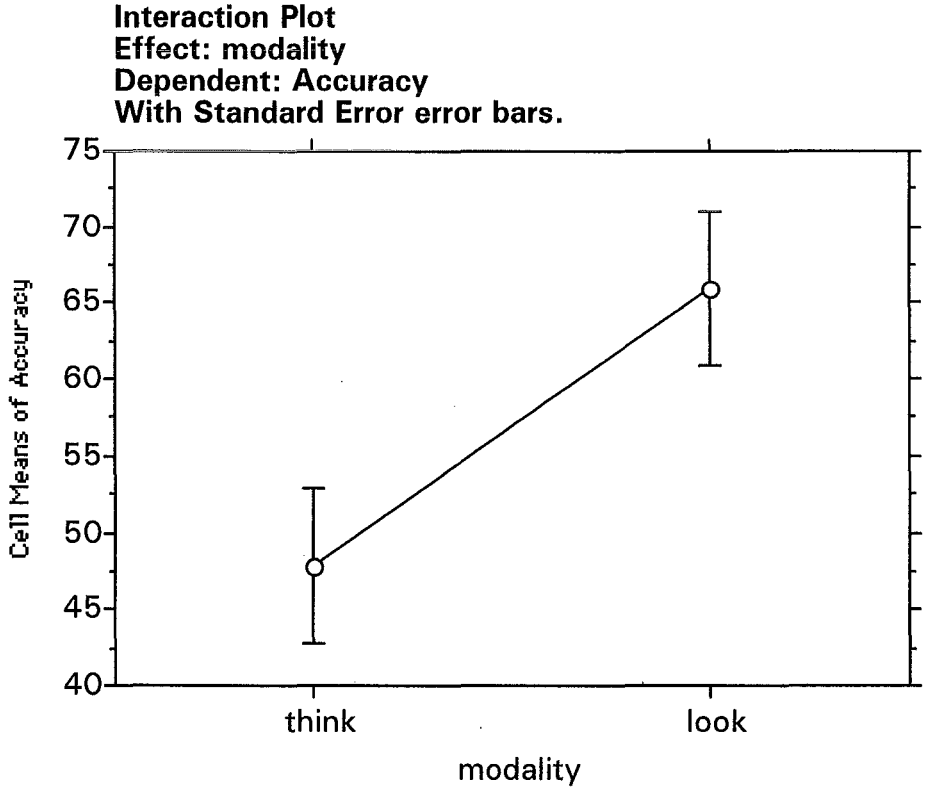

Figure 1. Difference between the mean 'look' score and the mean 'think' score.

Figure 2. Difference between the mean 'self' score and the mean 'other' score.

The only significant interaction effect was between *person* and *modality*, F(1,34) = 9.14, $p < .01$. Simple tests of main effects were performed on the interaction effect between *person* and modality. The 'self'/ 'look' question was answered with greater accuracy than the 'other'/ 'look' question, F(1,34) = 13.00, $p < .01$, and the 'self'/ 'think' question, F(1,34) = 17.18, $p < .01$. There was no significant difference between 'other'/ 'think' and 'other'/ 'look', $F < 1$, or between 'other'/ 'think' and 'self'/ 'think', $F < 1$. Figure 3 shows the interaction effect between *person* and *modality.* There was no interaction effect between *group* and *person*, $F < 1$. No other effects were significant.

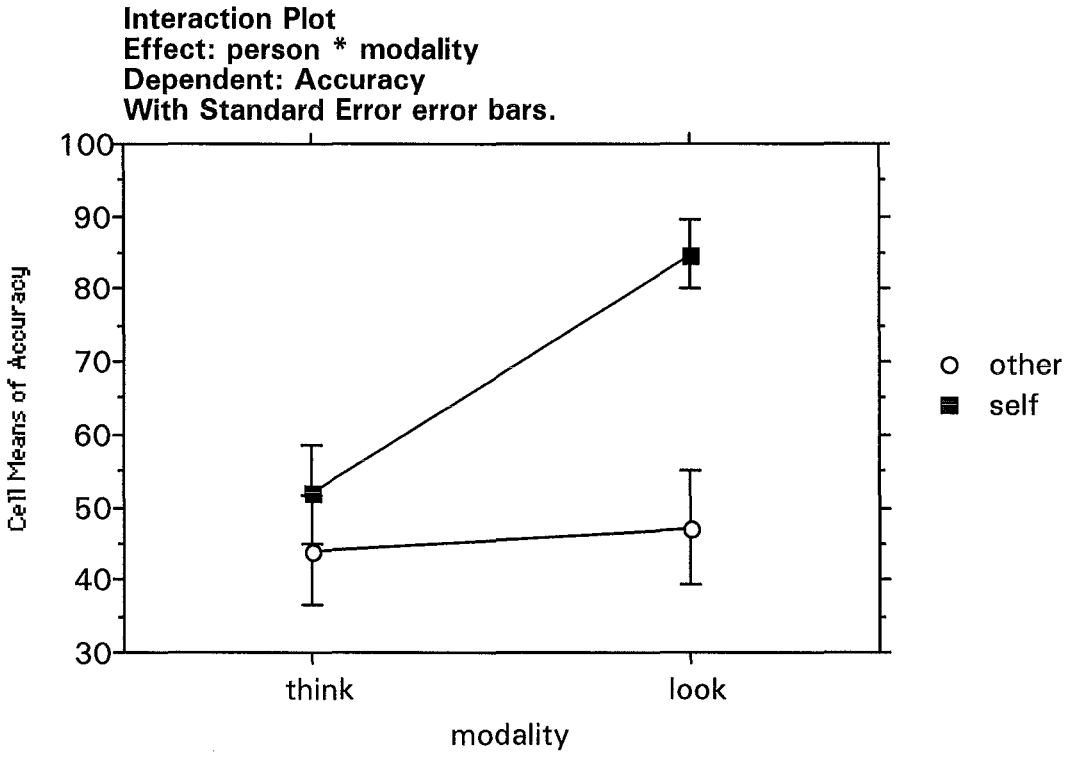

Figure 3. Interaction effect between *person* and *modality.*

DISCUSSION

1. Conclusions.

Five conclusions can be drawn from the results, based upon the predictions put forward in the 'first-person theorist' account (see part three of the introduction). The five conclusions are as follows:

a) Accuracy in answering the test questions did not increase with age. The ability to understand the behavioural consequences or representational nature of belief did not develop significantly between the third and fourth birthdays.

b) The *self / look* question was answered with greater accuracy than the *self / think* and *other / think* questions. Young children understand the behavioural consequences of psychological states such as belief in themselves before they understand the representational nature of those states.

c) The *self / look* question was answered with greater accuracy than the *other / look* question. Young children understand the behavioural consequences of their own psychological states before they understand the behavioural consequences of psychological states in others.

d) No significant difference was found between the accuracy of the participation group and that of the non-participation group. Personal involvement of the subject in the

experimental task does not appear to increase accuracy on the test questions. The lack of the predicted *person/ group* interaction effect is not interesting, due to the lack of a *group* main effect. If there had been both *person* and *group* main effects the lack of an interaction effect between the two would have been worth discussion, but in the present results the lack of an interaction effect can be explained by the fact that there is no significant *group* effect for *person* to interact *with.*

e) The *self / look* question was answered with greater accuracy than the *other / look, self / think,* and *other / think* questions. Young children understand the behavioural consequences of their own beliefs before they understand similar consequences of the beliefs of others, or the representational nature of belief in either themselves or other people.

2. Implications.

The present finding that the ability to understand the behavioural consequences or representational nature of belief does not develop significantly between the child's third and fourth birthday is in agreement with Gopnik (1993), who notes that the ability to understand false belief "...consistently appear(s) at around age four" (p.5). It is possible that development of the ability to understand false belief is rapid rather than gradual, and does not tend to occur until the child is approximately four years old. The age range of subjects in the present study was evenly spread.

The present finding that the *look* questions were answered more accurately than *think* questions (at least for *self*) is a successful replication of a finding of Chandler and Hala (1994).

Gopnik (1993) compares several sources of developmental evidence, some of which concern the child's understanding of other people's false beliefs, and some of which concern the child's understanding of their own false beliefs. Gopnik reports that the age at which children begin to pass the false belief test is approximately the same age at which children begin to pass the representational change test. Gopnik concludes that the ability to understand false belief, in both self and others, develops as the child reaches four years of age. The present finding, that young children understand the behavioural consequences of their own beliefs better than they understand the behavioural consequences or representational nature of belief in others, runs contrary to the findings of Gopnik (1993).

The present finding suggests that young children have at least an implicit understanding of the relationship between their actions and beliefs before they have any such understanding of belief in others. Gopnik (1993) claims that young children have as much understanding of the psychological states of others as they have of their own psychological states. However, Gopnik does not explicitly state that young children understand the behavioural consequences of psychological states to the same degree in both self and other. If Gopnik's (1993) claims were taken at face value, then the present findings would not present any discrepancy, but those claims have wider implications. The child's understanding of psychological states includes not only the explicit understanding of those states tested by the *think* questions, but also the implicit understanding of the behavioural consequences of those states, which is tested by the

look questions. In order to have a complete understanding of belief the young child must understand the behavioural consequences of belief, thus the present finding that children have a superior understanding of the behavioural consequences of their own beliefs is in opposition to the earlier findings of Gopnik (1993).

The discrepancy between the findings reported by Gopnik and those of the present study could be due to methodological differences between the two studies. There are two noteworthy methodological differences between the studies, described below, one of which may account for the discrepancy. Gopnik (1993) compared false belief and representational change results from various studies in order to come to the conclusion that the child's theoretical understanding of their own false beliefs, and those of other people, develop simultaneously. Gopnik's conclusions were, by practical necessity, based upon results gained from different subject populations. The present study, on the other hand, compared false belief and representational change scores within a single subject population. The advantage of testing children's understanding of false belief in self and other within a single subject population is that there is less chance of methodological faults in individual studies causing a biased result. There is no apparent bias which might be caused by the methodological difference described above, but a second difference may account for the discrepancy.

The *look* questions, used in the present study after Chandler and Hala (1994), were not used by Gopnik (1993). The present finding, that subjects answered the *self / look* question with significantly greater accuracy than all other test questions, can be explained in a manner which is consistent with Gopnik (1993). It is possible that the *self / look* question can be answered correctly without any understanding of psychological states whatsoever, if the child simply recalls where they looked for the

missing object in the representational change component of an experimental trial. In short, an understanding of the behavioural consequences of false belief may be necessary to predict where another person will look, but simple memory recall may be all that is needed to say where the subject themselves had looked.

There is another possible explanation. Subjects may answer the *self / look* question by thinking of where they *would look* instead of where they *did look.* Adults often employ a similar tactic if they cannot easily remember a past action. For example, a person who asks themselves "where did I put my car keys?" will often convert the question to "where *would* I have put my car keys?" in the hope of finding the correct answer by retracing their steps. Which of these two explanations of the present finding is correct is an empirical issue, and suggestions for its resolution are put forward in part four of the discussion.

The present finding that the personal involvement of subjects in the experimental task did not increase accuracy on the test questions runs contrary to the findings of Chandler and Hala (1994). The procedure of the present study and that of Chandler and Hala are compared in part three of the discussion to see whether this discrepancy can be understood.

The interaction between *person* (self/other) and *modality* (look/think) is interesting in the context of the major prediction of first-person theory theory, that children understand their own psychological states before understanding such states in others. The present finding is that the child has an understanding of the behavioural consequences of their own beliefs which is greater than their understanding of the representational nature of their own beliefs and, more importantly with regard to the

first-person theory theory, is also greater than their understanding of the behavioural consequences or representational nature of other people's beliefs.

The results of the present study refute the 'hard' version of theory theory described by theorists such as Gopnik (1993), Gopnik and Wellman (1992), and Moses and Chandler (1992), unless further empirical testing suggests that children answer the *self / look* question by simple recall rather than a superior understanding of the behavioural consequences of one's own false beliefs. Gopnik (1993) describes the child's theory of mind as an explanatory construct which is applied equally to one's own behaviour, and to the behaviour of others. The present study provides evidence that three-year-old children have an understanding of the behavioural consequences of their own psychological states which is superior to their understanding of such states in others. The present study provides evidence to support the developmental priority of self knowledge by demonstrating that three-year-olds are significantly more accurate when answering questions about their own belief-based behaviour than they are when answering questions about other people's behaviour or beliefs. The young child's superior understanding of their own psychological states is all the more impressive given claims that it is harder to understand one's own former false beliefs than it is to understand one's own current false beliefs (Harris, 1991).

The results of the present study are compatible with simulation theory. A simulation theorist might claim that the children in the present study had a greater understanding of the behavioural consequences of their own beliefs (than of the beliefs of others) because simulation is required to understand other people's false beliefs, and three-year-old children have trouble running such complex simulations, whereas less

simulation (i.e., fewer counterfactual steps) is required to model the behavioural consequences of one's own false beliefs.

It is possible to claim that simulation of another person's current false beliefs and simulation of one's own past false beliefs are equally difficult processes, having the same number of counterfactual steps (Harris, 1991), and therefore young children should not be able to answer questions about their own past false beliefs with any greater accuracy than questions about another person's current false beliefs. It is possible that the present study did not compare the child's understanding of past personal beliefs and the current beliefs of others, but instead compared the child's understanding of past personal beliefs and the *future* beliefs of others. For example, when each subject is asked "Where will (E2) think the milo is? In the milo box or in the soap pad box?", they are in fact being asked to comment upon a future psychological state, which (according to simulation theory) should be of equivalent simulation difficulty to a past psychological state (Harris, 1991). Therefore, if the present study did compare the child's understanding of their own past beliefs with the future beliefs of another person, then it can be argued that the present results are incompatible with simulation theory, as it is proposed by Harris (1991).

The 'first-person theory theory' (introduced in part three of the introduction) is the only form of theory theory which is compatible with the present findings, as it allows for the possibility that young children may develop a theory of mind which is first used to explain one's own behaviour, and is only later applied to the behaviour of others. There are two elements which constitute the first-person theorist account: developmental priority of self knowledge, and the necessity of personal awareness of psychological experience for theory of mind development. The present finding that

young children have a greater understanding of the behavioural consequences of their own false beliefs than of the false beliefs of others constitutes evidence that self knowledge has developmental priority.

The present findings do not support the necessity of personal awareness of psychological experience for theory of mind development. The first-person theory theory predicted that if awareness of personal psychological experience was necessary during theory of mind development then personal involvement should increase accuracy on the *self* questions to a significantly greater degree than on the *other* questions. The present findings were that there was no such increase in accuracy in the participation group. Future versions of first-person theory theory need not propose any role for psychological experience in theory of mind development. An alternative explanation of the present finding, that there was no significant difference between the participation group and the non-participation group, is that the personal involvement manipulation did not significantly alter the psychological experience of the participation group. I will consider the possibility that the personal involvement manipulation was ineffective in part three of the discussion.

To summarise, the present findings support first-person theory theory, but until possible alternative explanations of the evidence have been empirically tested, the present study must be considered inconclusive. The results could be explained in terms of simulation theory, theory theory, and first-person theory theory. Several variations of simulation theory exist which allow it to interpret any results of false belief studies in its favour. Further empirical research is needed to determine the validity of simulation theory. The present results are incompatible with theory theory, unless it is the case that subjects in the present study answered the *self / look* question through simple recall

rather than understanding of false belief. Suggestions for further testing of first-person theory theory are presented in part four of the discussion.

3. Limitations of the present study.

Failure on control questions.

Twenty out of the initial forty-eight subjects failed the control questions in all three experimental trials. The control questions used in the present study are the same as those used in Gopnik and Astington (1988). The control question failure rate reported by Gopnik and Astington (four out of fourteen three-year-olds) was lower than the rate reported in the present study, and much lower rates were reported by Chandler and Hala (1994). The characteristics of the present subject population are described below, in an attempt to understand what factors may have contributed to the control question failure.

There was no significant difference between the mean age of those subjects who passed the control questions (42.6 months) and the mean age of those who failed the control questions (41.3 months). The lack of significant age difference between the two populations rules out the possibility that the study was biased by the mass failure of the younger three-year-olds, who may have had particular difficulties with the control questions. The average age of three-year-old subjects run by Gopnik and Astington (1988) was 42.7 months, while the average age of subjects in the present study was 42.6 months, so age difference is not responsible for the discrepancy in control failure rates between the two studies.

The clear majority of the initial twenty subjects who failed the control questions failed the memory question, which tests the child's ability to remember where the objects were at the beginning of each trial. Out of a potential sixty failures (one per trial, three trials per subject), those subjects who were excluded from the study failed the memory question forty-nine times. In contrast, the reality question was only failed six times (also out of a potential sixty).

It is possible that the mass failure on the memory question can be explained by the findings of Taylor, Esbensen, and Bennett (1994). As was noted in part two of the introduction, Taylor et al. (1994) found that children as old as four and five years claim to have always known information which they have in fact just learned. Although young children's tendency to claim that they have always known novel information may not be a simple memory deficit, the same phenomenon may be the cause of failure on the memory question in the present study. It is possible that the cognitive feature (or lack thereof) which causes some children to claim that they have always known novel information may also cause those children to claim that an object has always been in its current position.

Although the effect described by Taylor, Esbensen, and Bennett (1994) may have contributed to the high control failure rate of the present study, it is highly improbable that the effect is completely responsible, as subjects run by Gopnik and Astington (1988) answered the same memory control question with lower failure rates. There is no obvious cause for the high control failure rate of the present study, although it is possible that the effect described by Taylor et al is a contributing factor.

Present other, past self.

An unfortunate methodological feature of the present study is that the subjects were asked questions about the current beliefs of another person, while they could only be asked questions about their own past beliefs. Researchers cannot ask children to reflect upon their *current false beliefs,* because the moment the child understands the belief to have been false *it is already a past false belief.* Normal people do not continue to hold beliefs despite knowing them to be false, except in abnormal circumstances, such as optical illusions (Schiffman, 1990).

The methodological necessity of questions about one's own past beliefs means that simulation theorists can explain false belief evidence, no matter the result. For example, the findings of the present study may be explained easily if simulation theory is correct. Simulation theory states that the young child should have a superior understanding of their own psychological states, because they can simply 'read' those states from an internal model of the child's own mind. The ability to simulate that model in order to understand the psychological states of others develops over time, so the child will have a developing understanding of other people's psychological states which is not as comprehensive as their understanding of their own psychological states. Simulation theory can also be used to explain experimental evidence which contradicts the present study. Harris (1993) explains the findings of Gopnik (1993), that young children have no greater understanding of their own psychological states than they have of other people's states, by claiming that one's own past false beliefs are just as hard to simulate as another person's current false beliefs. 'Hard' theory theorists such as Gopnik (1993) cannot criticise the present study for using present tense test questions in the false belief test and past tense questions in the representational change test, because

to do so would be criticising the methodology (and thus conclusions) of their own studies, which use the same methodology.

Cognitive involvement and non-involvement.

Chandler and Hala (1994) claim that even young three-year-olds can pass a false belief test if they have personal involvement in the execution of the test. The present study failed to replicate Chandler and Hala's (1994) finding that personal involvement of the child in the false belief task increased the child's accuracy in answering the false belief test questions.

There are two methodological distinctions to be made between the studies conducted by Chandler and Hala (1994) and the present study, although neither distinction would account for the present failure to replicate Chandler and Hala's findings. The first difference is that three of the four studies conducted by Chandler and Hala did not include non-participation groups, although the non-participation group in the fourth study was the same as that in the present study. The second difference is that the subjects in Chandler and Hala (1994) completed either a false belief test or a representational change test, whereas subjects in the present study completed both.

It may be that the failure of the present study to replicate Chandler and Hala's results is due to methodological limitations of the present study, rather than there being no effect to replicate. There may have been insufficient differentiation between cognitive involvement of experimental subjects and non-involvement of control subjects in the present study. Although the non-participation subjects did not have the choice of which props to use in each trial, and did not have the same degree of "hands on" involvement as the participation subjects, these manipulations did not appear to be

major factors in determining the degree of each child's enthusiasm or interest in the task (which would presumably correspond to that child's degree of 'cognitive involvement'). Suggestions for heightening the differentiation between the experiences of participation and non-participation subjects are discussed in the next section.

4. Future research.

Further differentiation of involvement and non-involvement.

There may be a lack of differentiation between the experiences of the subjects in the participation group and those in the non-participation group. Greater differentiation between the experiences of these two groups may allow the successful replication of Chandler and Hala's (1994) findings. The essence of the problem is the need to maintain an equivalent level of interest and enthusiasm between the two groups, while increasing the cognitive involvement of the participation group or decreasing the cognitive involvement of the non-participation group.

One possibility is to have the participation group actually participate in the trials, as they do in the present study, while the non-participation group is forced into a passive role by watching examples of the trials played from video tape. The lack of "right here, right now" salience might decrease cognitive involvement, while the novelty of the video should keep children interested enough to answer the questions.

Testing the first-person theory theory.

There are two elements which constitute the full version of first-person theory theory as it is described in part three of the introduction. The second element is the

necessity of personal awareness of psychological experience for theory of mind development. If awareness of one's own psychological experience is necessary for development of an understanding of one's own psychological states, then young children and children with autism who do not understand their own psychological states should not have such an awareness. Flavell et al (1993) are among those who have begun to explore the area of the young child's understanding of psychological experience, but such studies are not common, and do not include children with autism. Studies which investigate the autistic child's understanding of psychological experience should be carried out to find whether autistic children have any less understanding of psychological experience than normal children, and if so, to find out what aspects of the autistic child's understanding are typically impaired.

Studies could be carried out which would investigate the possibility that young children may have a greater understanding of their own psychological experience than they have of the psychological experiences of others. The type of 'stream of consciousness' questionnaire employed by Flavell et al (1993) could be modified to test children's understanding of certain features of human psychological experience, both in themselves and others. Qualitative studies could be carried out which would question individual children in depth about their understanding of the psychological states or experiences of themselves and others.

Further empirical studies are needed to test 'hard' theory theory, first-person theory theory, and simulation theory. In part two of the discussion it was explained that the present study constitutes evidence against 'hard' theory theory, unless subjects in the present study were answering the *self / look* question by simple recall rather than understanding the behavioural consequences of false belief. A study could be carried

out in which the *self / look* question ("where did you look for the object?") is balanced with an alternative *self / look* question which, if answered correctly, shows that the child understands the behavioural consequences of false belief (such as "where *would* you look for the object?"). If the original *self / look* question is answered with significantly greater accuracy than the alternative version, then it is being answered by simple recall.

Studies designed to empirically test first-person theory theory and simulation theory should be carried out, but the two theories are extremely hard to differentiate on a practical level. For example, despite the different cognitive mechanisms postulated by the two theories to account for the child's developing understanding of psychological states, both theories predict that self knowledge has developmental priority and that understanding of one's own psychological states (aswell as other people's) develops over time. I do not claim that simulation theory and first-person theory theory are empirically indistinguishable, but I cannot suggest what empirical basis upon which the two theories might be distinguished. The apparent empirical similarity of simulation theory and first-person theory theory only serves to emphasise the practical unimportance of asking whether the child's understanding of psychological states is theoretical in nature, or based upon a process of simulation.

In conclusion, the present study has two significant findings which are of interest in the context of the proposed first-person theory theory. The first is that young children understand the behavioural consequences of their own psychological states before they understand the representational nature of those states, which is a replication of a finding of Chandler and Hala (1994). The second is that young children understand the behavioural consequences of their own psychological states before they understand the behavioural consequences or representational nature of psychological states in

others, which is refutation of the findings of Gopnik (1993). In short, the young child understands the behavioural consequences of their own false beliefs significantly better than they understand the behavioural consequences of other people's false beliefs, or the representational nature of their own or other people's false beliefs. The implications of these findings, which can be explained by both simulation theory and a simplified version of first-person theory theory, have been discussed. Further research must now be undertaken to decide which theory best explains the development of the child's understanding of belief.

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Appendices

Appendix A.

Subject conditions table.

SUBJECT	GROUP	Test question order	Forced choice order	Trial order
1	E	1,2	U,E	ABC
2	E	1,2	U,E	BCA
3	E	1,2	U,E	CAB
4	E	1,2	U,E	ABC
5	E	1,2	U,E	BCA
6	E	1,2	U,E	CAB
7	E	1,2	E,U	ABC
8	E	1,2	E,U	BCA
9	E	1,2	E,U	CAB
10	E	1,2	E,U	ABC
11	E	1,2	E,U	BCA
12	E	1,2	E,U	CAB
13	E	2,1	U,E	ABC
14	E	2,1	U,E	BCA
15	E	2,1	U,E	CAB
16	E	2,1	U,E	ABC
17	E	2,1	U,E	BCA
18	E	2,1	U,E	CAB
19	E	2,1	E,U	ABC
20	E	2,1	E,U	BCA
21	E	2,1	E,U	CAB
22	E	2,1	E,U	ABC
23	E	2,1	E,U	BCA
24	E	2,1	E,U	CAB
25	C	1,2	U,E	ABC
26	C	1,2	U,E	BCA
27	C	1,2	U,E	CAB
28	C	1,2	U,E	ABC
29	C	1,2	U,E	BCA
30	C	1,2	U,E	CAB
31	C	1,2	E,U	ABC
32	C	1,2	E,U	BCA
33	C	1,2	E,U	CAB
34	C	1,2	E,U	ABC
35	C	1,2	E,U	BCA
36	C	1,2	E,U	CAB
37	C	2,1	U,E	ABC
38	C	2,1	U,E	BCA
39	C	2,1	U,E	CAB
40	C	2,1	U,E	ABC
41	C	2,1	U,E	BCA
42	C	2,1	U,E	CAB
43	C	2,1	E,U	ABC
44	C	2,1	E,U	BCA
45	C	2,1	E,U	CAB
46	C	2,1	E,U	ABC
47	C	2,1	E,U	BCA
48	C	2,1	E,U	CAB

E=experimental C=control / U=unexpected contents E=expected contents

Appendix B.

Scripts.

SCRIPT

EXPERIMENTAL GROUP

PROP A

E1 *opens the icecream cone box.* What's in this box?

child it's empty/nothing

E1 *opens the soap dish.* What's in the soap dish?

child soap

E2 that looks like pretty soap. (E1), can I smell that soap?

E1 okay, but could you go and get me a pencil first please?

E2 okay. *E2 leaves area.*

E1 *to child:* I've got an idea. Let's hide the soap from (E2) in the icecream cone box, where she won't see it. *E1 indicates for child to do so.* Why don't you put one of these coloured balls in the soap dish. *E1 offers range of three coloured balls, indicates to soap dish.* Close the soap dish, so (E2) doesn't see. ***E1 asks two test questions. E1 then asks two control questions.***

E2 *re-enters area.* Hi guys. Here's your pencil, (E1). Can I smell the soap now?

E1 sure, you can.

E2 *opens soap dish and feigns surprise at coloured ball. Shows coloured ball to E1 and child.* Hey! Where did the soap go? I don't understand. *While E1 briefly distracts the child, E2 turns away and discretely swaps the soap dish which contains the coloured ball for a soap dish which contains soap.*

E1 *to child:* Let's put the soap back again. Can you do that? *Child opens soap dish to find soap, and is surprised.* ***E1 asks two test questions.***

SCRIPT

EXPERIMENTAL GROUP

PROP B

E1 *opens the icecream container.* What's in this container?

child it's empty/nothing

E1 *opens the weetbix box.* What's in the weetbix box?

child weetbix

E2 that looks like yummy weetbix. (E1), can I taste that weetbix?

E1 okay, but could you go and get me a ruler first please?

E2 okay. *E2 leaves area.*

E1 *to child:* I've got an idea. Let's hide the weetbix from (E2) in the icecream container, where she won't see it. *E1 indicates for child to do so.* Why don't you put one of these animals in the weetbix box. *E1 offers range of three soft toys, indicates to weetbix box.* Close the weetbix box, so (E2) doesn't see. ***E1 asks two test questions. E1 then asks two control questions.***

E2 *re-enters area.* Hi guys. Here's your ruler, (E1). Can I taste the weetbix now?

E1 sure, you can.

E2 *opens weetbix box and feigns surprise at soft toy. Shows soft toy to E1 and child.* Hey! Where did the weetbix go? I don't understand. *While E1 briefly distracts the child, E2 turns away and discretely swaps the weetbix box which contains the soft toy for a weetbix box which contains weetbix.*

E1 *to child:* Let's put the weetbix back again. Can you do that? *Child opens weetbix box to find weetbix, and is surprised.* ***E1 asks two test questions.***

SCRIPT

EXPERIMENTAL GROUP

PROP C

E1 *opens the soap pad box.* What's in this box?

child it's empty/nothing

E1 *opens the milo box.* What's in the milo box?

child milo

E2 that looks like yummy milo. (E1), can I taste that milo?

E1 okay, but could you go and get me a pen first please?

E2 okay. *E2 leaves area.*

E1 *to child:* I've got an idea. Let's hide the milo from (E2) in the soap pad box, where she won't see it. *E1 indicates for child to do so.* Why don't you put one of these lollies in the milo box. *E1 offers range of three coloured lollies, indicates to milo box.* Close the milo box, so (E2) doesn't see. ***E1 asks two test questions. E1 then asks two control questions.***

E2 *re-enters area.* Hi guys. Here's your pen, (E1). Can I taste the milo now?

E1 sure, you can.

E2 *opens milo box and feigns surprise at lolly. Shows lolly to E1 and child.* Hey! Where did the milo go? I don't understand. *While E1 briefly distracts the child, E2 turns away and discretely swaps the milo box which contains the lolly for a milo box which contains milo.*

E1 *to child:* Let's put the milo back again. Can you do that? *Child opens milo box to find milo, and is surprised.* ***E1 asks two test questions.***

SCRIPT

EXPERIMENTAL GROUP

PROP 1

E1 *opens the laundry powder box.* What's in this box?

child it's empty/nothing

E1 *opens the toothpaste box.* What's in the toothpaste box?

child toothpaste

E2 is that peppermint toothpaste?. (E1), can I taste that toothpaste?

E1 okay, but could you go and get me a felt pen first please?

E2 okay. *E2 leaves area.*

E1 *to child:* I've got an idea. Let's hide the toothpaste from (E2) in the laundry powder box, where she won't see it. *E1 indicates for child to do so.* Why don't you put one of these candles in the toothpaste box. *E1 indicates for child to do so.* Let's close the toothpaste box, so (E2) doesn't see. ***E1 asks two test questions. E1 then asks two control questions.***

E2 *re-enters area.* Hi guys. Here's your felt pen, (E1). Can I taste the toothpaste now?

E1 sure, you can.

E2 *opens toothpaste box and feigns surprise at candle. Shows candle to E1 and child.* Hey! Where did the toothpaste go? I don't understand.

E1 *to child:* Why don't you put the toothpaste back again. *E1 indicates for child to open the toothpaste box and put the toothpaste back.*

SCRIPT

EXPERIMENTAL GROUP

PROP 2

E1 *opens the chip box.* What's in this box?

child it's empty/nothing

E1 *opens the biscuit packet.* What's in the biscuit packet?

child a biscuit

E2 that biscuit looks really yummy. (E1), can I taste that biscuit?

E1 okay, but could you go and get me a rubber first please?

E2 okay. *E2 leaves area.*

E1 *to child:* I've got an idea. Let's hide the biscuit from (E2) in the chip box, where she won't see it. *E1 indicates for child to do so.* Why don't you put this pair of glasses in the biscuit packet. *E1 indicates for child to do so.* Let's close the biscuit packet, so (E2) doesn't see. ***E1 asks two test questions. E1 then asks two control questions.***

E2 *re-enters area.* Hi guys. Here's your rubber, (E1). Can I taste the biscuit now?

E1 sure, you can.

E2 *opens biscuit packet and feigns surprise at glasses. Shows glasses to E1 and child.* Hey! Where did the biscuit go? I don't understand.

E1 *to child:* Why don't you put the biscuit back again. *E1 indicates for child to open the biscuit packet and put the biscuit back.*

SCRIPT

CONTROL GROUP

PROP A

E1 *opens the icecream cone box.* What's in this box?

child it's empty/nothing

E1 *opens the soap dish.* What's in the soap dish?

child soap

E2 that looks like pretty soap. (E1), can I smell that soap?

E1 okay, but could you go and get me a pencil first please?

E2 okay. *E2 leaves area.*

E1 *to child:* I've got an idea. I'm going to hide the soap from (E2) in the icecream cone box, where she won't see it. *E1 does so.* I'm also going to put one of these coloured balls in the soap dish. *E1 does so.* I'll close the soap dish, so (E2) doesn't see. ***E1 asks two test questions. E1 then asks two control questions.***

E2 *re-enters area.* Hi guys. Here's your pencil, (E1). Can I smell the soap now?

E1 sure, you can.

E2 *opens soap dish and feigns surprise at coloured ball. Shows coloured ball to E1 and child.* Hey! Where did the soap go? I don't understand. *While E1 briefly distracts the child, E2 turns away and discretely swaps the soap dish which contains the coloured ball for a soap dish which contains soap.*

E1 *to child:* I'm going to put the soap back again. *E1 opens soap dish to find soap, and child is surprised.* ***E1 asks two test questions.***

SCRIPT

CONTROL GROUP

PROP B

E1 *opens the icecream container.* What's in this container?

child it's empty/nothing

E1 *opens the weetbix box.* What's in the weetbix box?

child weetbix

E2 that looks like yummy weetbix. (E1), can I taste that weetbix?

E1 okay, but could you go and get me a ruler first please?

E2 okay. *E2 leaves area.*

E1 *to child:* I've got an idea. I'm going to hide the weetbix from (E2) in the icecream container, where she won't see it. *E1 does so.* I'm also going to put one of these animals in the weetbix box. *E1 does so.* I'll close the weetbix box, so (E2) doesn't see. ***E1 asks two test questions. E1 then asks two control questions.***

E2 *re-enters area.* Hi guys. Here's your ruler, (E1). Can I taste the weetbix now?

E1 sure, you can.

E2 *opens weetbix box and feigns surprise at soft toy. Shows soft toy to E1 and child.* Hey! Where did the weetbix go? I don't understand. *While E1 briefly distracts the child, E2 turns away and discretely swaps the weetbix box which contains the soft toy for a weetbix box which contains weetbix.*

E1 *to child:* I'm going to put the weetbix back again. *E1 opens weetbix box to find weetbix, and child is surprised.* ***E1 asks two test questions.***

SCRIPT

CONTROL GROUP

PROP C

E1 *opens the soap pad box.* What's in this box?

child it's empty/nothing

E1 *opens the milo box.* What's in the milo box?

child milo

E2 that looks like yummy milo. (E1), can I taste that milo?

E1 okay, but could you go and get me a pen first please?

E2 okay. *E2 leaves area.*

E1 *to child:* I've got an idea. I'm going to hide the milo from (E2) in the soap pad box, where she won't see it. *E1 does so.* I'm also going to put one of these lollies in the milo box. *E1 does so.* I'll close the milo box, so (E2) doesn't see. ***E1 asks two test questions. E1 then asks two control questions.***

E2 *re-enters area.* Hi guys. Here's your pen, (E1). Can I taste the milo now?

E1 sure, you can.

E2 *opens milo box and feigns surprise at lolly. Shows lolly to E1 and child.* Hey! Where did the milo go? I don't understand. *While E1 briefly distracts the child, E2 turns away and discretely swaps the milo box which contains the lolly for a milo box which contains milo.*

E1 *to child:* I'm going to put the milo back again. *E1 opens milo box to find milo, and child is surprised.* ***E1 asks two test questions.***

SCRIPT

CONTROL GROUP

PROP 1

E1 *opens the laundry powder box.* What's in this box?

child it's empty/nothing

E1 *opens the toothpaste box.* What's in the toothpaste box?

child toothpaste

E2 is that peppermint toothpaste?. (E1), can I taste that toothpaste?

E1 okay, but could you go and get me a felt pen first please?

E2 okay. *E2 leaves area.*

E1 *to child:* I've got an idea. I'm going to hide the toothpaste from (E2) in the laundry powder box, where she won't see it. *E1 does so.* I'm also going to put one of these candles in the toothpaste box. *E1 does so.* I'll close the toothpaste box, so (E2) doesn't see. ***E1 asks two test questions. E1 then asks two control questions.***

E2 *re-enters area.* Hi guys. Here's your felt pen, (E1). Can I taste the toothpaste now?

E1 sure, you can.

E2 *opens toothpaste box and feigns surprise at candle. Shows candle to E1 and child.* Hey! Where did the toothpaste go? I don't understand.

E1 *to child:* I'm going to put the toothpaste back again. *E1 opens toothpaste box and puts the toothpaste back.*

SCRIPT

CONTROL GROUP

PROP 2

E1 *opens the chip box.* What's in this box?

child it's empty/nothing

E1 *opens the biscuit packet.* What's in the biscuit packet?

child a biscuit

E2 that biscuit looks really yummy. (E1), can I taste that biscuit?

E1 okay, but could you go and get me a rubber first please?

E2 okay. *E2 leaves area.*

E1 *to child:* I've got an idea. I'm going to hide the biscuit from (E2) in the chip box, where she won't see it. *E1 does so.* I'm also going to put this pair of glasses in the biscuit packet. *E1 does so.* I'll close the biscuit packet, so (E2) doesn't see. ***E1 asks two test questions. E1 then asks two control questions.***

E2 *re-enters area.* Hi guys. Here's your rubber, (E1). Can I taste the biscuit now?

E1 sure, you can.

E2 *opens biscuit packet and feigns surprise at glasses. Shows glasses to E1 and child.* Hey! Where did the biscuit go? I don't understand.

E1 *to child:* I'm going to put the biscuit back again. *E1 opens biscuit packet and puts the biscuit back.*

Appendix C.

Information sheet.

University of Canterbury

Department of Psychology

Early childhood learning project:

Children's understanding of belief.

INFORMATION

Your three-year-old child is invited to participate as a subject in the research project "Children's understanding of belief". The aim of this project is to determine whether any three-year-old children can pass tests which evidence an understanding of their own beliefs, while not being able to evidence a similar understanding of other people's beliefs (or vice versa).

Your child's involvement in this project will be to participate in the following activities:

1. Helping one researcher to trick another by replacing the soap in a soap dish with coloured balls, and answering questions about what the tricked researcher believes, such as: "Where will Jenni think the soap is, in the soap dish or in the icecream cone box?"
2. Opening a soap dish, finding that it has unexpected contents (soap instead of coloured balls), and answering questions about what the child believed, such as: "Before you looked in the soap dish just now, where did you think the soap was; in the soap dish or in the icecream cone box?"

The results of the project may be published, but you are assured of the complete confidentiality of data gathered in this investigation. The identity of participants will not be made public and only group data will be reported.

The project is being carried out by Matthew Twyman under the direction of Dr. Gillian Rhodes. Matthew Twyman can be contacted at 366 7001 7197. Dr. Rhodes can be contacted at 326 5531. We will be pleased to discuss any concerns you may have about your child's participation in the project.

The project has been reviewed and approved by the University of Canterbury Human Ethics Committee.

Appendix D.

Consent form.

Child's name: .....

Child's birthdate: .....

CONSENT FORM:

CHILDREN'S UNDERSTANDING OF BELIEF

I have read and understood the description of the above-named project. On this basis I agree to allow my child to participate as a subject in the project, and I consent to publication of the results of the project with the understanding that anonymity will be preserved. I understand also that my child may at any time withdraw or be withdrawn from the project, including withdrawal of any information they have provided.

Signed ..... Date .....

Appendix E.

Data sheet.

Subject #: Date:
Subject name: Condition: experimental
Sex: M F control
Daycare centre: Birthdate:

[ ] **soap dish**
[ ] Where will (E2) think the soap is?
In the soap dish [ ] or in the icecream cone box [ ] ?
[ ] Where will (E2) look for the soap?
In the soap dish [ ] or in the icecream cone box [ ] ?

*

--- When you first saw the soap, before we moved it, where was it?
In the soap dish [ ] or in the icecream cone box [ ] ?
--- Where is the soap now?
In the soap dish [ ] or in the icecream cone box [ ] ?

*

[ ] Before you looked in the soap dish just now, where did you think the soap was?
In the soap dish [ ] or in the icecream cone box [ ] ?
[ ] Where did you look for the coloured ball?
In the soap dish [ ] or in the icecream cone box [ ] ?

[ ] **weetbix box**
[ ] Where will (E2) think the weetbix is?
In the weetbix box [ ] or in the icecream container [ ] ?
[ ] Where will (E2) look for the weetbix?
In the weetbix box [ ] or in the icecream container [ ] ?

*

--- When you first saw the weetbix, before we moved it, where was it?
In the weetbix box [ ] or in the icecream container [ ] ?
--- Where is the weetbix now?
In the weetbix box [ ] or in the icecream container [ ] ?

*

[ ] Before you looked in the weetbix box just now, where did you think the weetbix was?
In the weetbix box [ ] or in the icecream container [ ] ?
[ ] Where did you look for the animal?
In the weetbix box [ ] or in the icecream container [ ] ?

[ ] **milo box**
[ ] Where will (E2) think the milo is?
In the milo box [ ] or in the soap pad box [ ] ?
[ ] Where will (E2) look for the milo?
In the milo box [ ] or in the soap pad box [ ] ?

*

--- When you first saw the milo, before we moved it, where was it?
In the milo box [ ] or in the soap pad box [ ] ?
--- Where is the milo now?
In the milo box [ ] or in the soap pad box [ ] ?

*

[ ] Before you looked in the milo box just now, where did you think the milo was?
In the milo box [ ] or in the soap pad box [ ] ?
[ ] Where did you look for the lolly?
In the milo box [ ] or in the soap pad box [ ] ?

[ ] **toothpaste box (control trial)**

[ ] Where will (E2) think the toothpaste is?

In the toothpaste box [ ] or in the laundry powder box [ ] ?

[ ] Where will (E2) look for the toothpaste?

In the toothpaste box [ ] or in the laundry powder box [ ] ?

*

--- When you first saw the toothpaste, before we moved it, where was it?

In the toothpaste box [ ] or in the laundry powder box [ ] ?

--- Where is the toothpaste now?

In the toothpaste box [ ] or in the laundry powder box [ ] ?

[ ] **biscuit packet (control trial)**

[ ] Where will (E2) think the biscuit is?

In the biscuit packet [ ] or in the laundry powder box [ ] ?

[ ] Where will (E2) look for the biscuit?

In the biscuit packet [ ] or in the laundry powder box [ ] ?

*

--- When you first saw the biscuit, before we moved it, where was it?

In the biscuit packet [ ] or in the laundry powder box [ ] ?

--- Where is the biscuit now?

In the biscuit packet [ ] or in the laundry powder box [ ] ?

COMMENTS:

Appendix F.

Data summary file.

other think A	other look A	ctrl1 A	ctrl2 A	self think A	self look A	other think B	other look B	ctrl1 B
0	0	0	1	1	1	1	0	1
1	0	1	1	1	1	1	0	1
0	0	1	1		1	0	0	1
0	1	1	1	1	1	1	1	1
1	0	1	1	1	1	1	0	0
0	1	0	1	1	1	1	1	1
0	0	1	1	1	1	0	0	1
1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	0	0	1
1	1	1	1	1	1	1	1	0
0	0	1	1		0	0	0	1
1	1	1	1	0	1	1	1	1
1	0	1	1	1	1	1	1	1
1	0	1	1	1	1	0	0	0
0	0	1	1	0	1	0	0	0
0	0	1	1	1	0	0	0	0
0	0	1	1	0	1	0	0	0
1	1	1	1	0	1	0	0	0
1	1	1	1	0	1	1	1	1
						1	1	1
1	0	1	0	1	0	0	0	0
0	0	1	1	1	0	0	1	1
0	0	1	1	1	1	0	0	0
0	0	1	1	1	1	0	0	1
1	0	0	1	1	1	1	1	1
0	0	0	1	0	0	0	0	0
1	1	1	1	0	1	0	0	0
1	1	1	1	1	0	0	0	0
0	1	1	1	0	1	1	1	0
0	0	1	1	1	1	1	0	0
0	0	0	1	1	1	0	0	1
0	0	0	1	1	1	0	0	1
1	1	0	1	0	1	0	1	1
0	0	0	1	0	0	0	0	0
1	0	0	1	1	0	0	1	1
1	0	0	1	0	1	0	1	1

ctrl2 B	self think B	self look B	other think C	other look C	ctrl1 C	ctrl2 C	self think C	self look C
1	1	1	0	0	1	1	0	0
1	1	1	0	0	1	1	1	1
1	0	1	0	0	1	1	1	1
1	1	1	1	1	1	1	0	1
0	1	1	1	0	1	1	0	1
1	1	1	0	1	1	1	0	1
1	0	1	0	0	1	1	0	1
1	1	1	1	1	1	1	0	0
1	0	1	0	1	1	1	0	0
0	0	1	1	1	1	0	0	1
1	0	1	0	1	1	1		
1	0	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	0
1	1	1	1	1	0	1	0	1
1	0	1	0	0	1	1	1	1
1	1	1	0	0	1	1	1	1
1	1	1	0	0	0	1	1	1
1	0	1	0	0	0	1	1	1
1	1	1	1	1	1	1	0	1
1	0	1	0	0	1	1	0	1
1	1	0	1	1	1	1	0	1
1	0	1	0	0	1	1	1	1
1	1	1	0	0	0	1	0	1
1	1	1	0	0	1	1	1	1
1	1	1	0	1	0	1	0	0
1	0		0	0	1	1	0	1
1	1	1	0	0	0	1	1	1
1	1	0	1	1	1	0	0	1
1	0	1	0	0	1	1	1	1
1	1	1	0	0	0	0	1	0
1	0	1	0	0	0	1	0	1
1	1	1	0	0	1	1	1	1
1	0	1	0	0	0	0	0	1
1	0	1	0	0	1	1	1	0
1	1	1	1	1	1	1	0	1
1	0	1	1	1	1	1	0	0

Appendix G.

Excel input table.

	accuracy (%)					
	other		self		overall	age
	think	look	think	look	performance	(mths)
1	50	0	50	50	38	43
1	67	0	100	100	67	44
1	0	0	33	100	33	38
1	67	100	67	100	83	38
1	100	0	50	100	63	43
1	50	100	50	100	75	36
1	0	0	33	100	33	44
1	100	100	67	67	83	42
1	0	67	33	67	42	42
1	100	100	100	100	100	47
1	0	33	0	33	17	39
1	100	100	33	100	83	45
1	100	67	100	67	83	45
1	100	0	100	100	75	45
1	0	0	50	100	38	41
1	0	0	100	50	38	38
1	0	0	0	100	25	44
2	100	100	0	100	75	47
2	100	100	33	100	83	46
2	50	50	0	100	50	45
2	100	100	0	100	75	42
2	0	33	67	67	42	42
2	0	0	100	100	50	42
2	0	0	100	100	50	47
2	100	100	100	100	100	41
2	0	0	0	100	25	44
2	100	100	0	100	75	46
2	100	100	100	0	75	39
2	0	50	50	100	50	39
2	0	0	100	100	50	47
2	0	0	0	100	25	40
2	0	0	100	100	50	43
2	0	100	0	100	50	43
2	0	0	100	0	25	45
2	50	100	50	100	75	38
2	50	100	0	50	50	43

group 1 = experimental (participation) group.

group 2 = control (non-participation) group.

Appendix H.

ANOVA summary table, means, and simple tests of main effects.

Type III Sums of Squares

Source	df	Sum of Squares	Mean Square	F-Value	P-Value
Group	1	22.325	22.325	.010	.9198
Subject(Group)	34	73731.085	2168.561		
person	1	18785.141	18785.141	7.939	.0080
person * Group	1	455.530	455.530	.193	.6636
person * Subjec...	34	80448.546	2366.134		
modality	1	11097.200	11097.200	8.439	.0064
modality * Group	1	2736.089	2736.089	2.081	.1583
modality * Subj...	34	44710.488	1315.014		
person * modality	1	8127.585	8127.585	9.136	.0047
person * modali...	1	472.308	472.308	.531	.4712
person * modali...	34	30247.602	889.635		

Dependent: Accuracy

Means Table
Effect: modality
Dependent: Accuracy

	Count	Mean	Std. Dev.	Std. Error
think	72	47.917	42.803	5.044
look	72	65.986	42.658	5.027

Means Table
Effect: person
Dependent: Accuracy

	Count	Mean	Std. Dev.	Std. Error
other	72	45.611	45.633	5.378
self	72	68.292	38.395	4.525

Means Table
Effect: person * modality
Dependent: Accuracy

	Count	Mean	Std. Dev.	Std. Error
other, think	36	44.000	45.287	7.548
other, look	36	47.222	46.561	7.760
self, think	36	51.833	40.423	6.737
self, look	36	84.750	28.271	4.712

Simple tests of main effects performed upon the interaction between *person* and *modality.*

effect	**MS n**	**DF n**	**DF e**	**MS e**	**F**	**P**
person at *think*	1100.076	1	34	1752.983	.628	.434
person at *look*	25812.651	1	34	1502.786	17.177	.000
modality at *other*	115.370	1	34	734.974	.157	.694
modality at *self*	19109.415	1	34	1469.675	13.002	.001